The New Zealand
Journal of Agriculture.

VOL. XXXVI. WELLINGTON, 20th JUNE, 1928. No. 6.

TOP-DRESSING OF HILL-COUNTRY PASTURES.

TRIALS ON KING-COUNTRY FARMS.*

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THE top-dressing of permanent pasture with fertilizers, a practice that now bulks largely in the farming of many districts, has of late received increasing attention from hill-country farmers also. To men who have no means of cultivating worn-out pastures the prospect of being able to achieve renovation by means of manuring is particularly attractive, and some thousands of tons of fertilizer annually are now applied by hand on the hill bush-lands of the King-country.

As was anticipated, there are many instances in which the fertilizer has wrought such a transformation that the outlay has been recovered with comparative ease. But, as was also anticipated, there are a number of cases in which the improvement has not yet been sufficient to enable the operation to be characterized as successful. Where the cost per acre is comparatively high and the return per acre, even under the best of management, must be comparatively low, it is highly important that the farmer should confine himself to practice that experience has shown to be capable of giving a fair return for outlay.

It was with the object of investigating the various factors involved in the economic side of hill-country top-dressing and of endeavouring to define as accurately as possible its economic limit that a series of co-operative trials was started, tentatively in 1924 and 1925, but on a larger scale in 1926. These trials are still in progress, but already various conclusions may be drawn affording useful information to hill-country settlers.

Carrying-capacity Trials.

Seeing that the ewe is easily the most profitable animal on the farm (leaving dairying out of account), and that the winter months from June to September represent the most critical season on all pastoral holdings, an effort has been made to ascertain the increase in ewe-wintering capacity on the various types of land. This has meant the manuring of ring-fenced paddocks and recording of stock carried before and after each dressing. The results to date are given in brief, as a full description of

* Some preliminary notes on this subject, entitled "Top-dressing of King-country Hill Lands," were published in the *Journal* for November, 1926.

the work at each of the thirteen centres operated in would be impossible within the limits of this article.

K. A. W. Mackenzie, Oparau, Kawhia County.—A nineteen-year-old bushfelling on light semi-volcanic loam, going strongly into danthonia. Top-dressed with 2 cwt. basic super per acre in September, 1926 (17s. 11d.),* and again in June, 1927 (16s.). Wintering-capacity increased from less than one ewe to a ewe and half a hogget. Stock much improved in condition, lambing percentage higher, and mortality lower; similar result with cattle.

Harty Bros., Honikiwi, Otorohanga County.—A twenty-three-year-old bushfelling on volcanic clay; rather steep; mainly danthonia. Paddock A: Top-dressed with 2 cwt. 44/46 super in August, 1925, and again in March, 1926; improvement very slow at first, but now represents an increase of 50 per cent. in wintering-capacity, with decided improvement in stock. Paddock B: 2 cwt. 44/46 super in June, 1926 (21s. 6d.), and again in April, 1927 (19s. 6d.); increased carrying-capacity, 40 per cent., and much improved condition in stock, especially in the lambs.

Tynan Bros., Te Anga, Kawhia County.—Ploughable land on poor clay formation, originally in manuka; brown-top dominant in pasture, with some paspalum. Paddock A: Top-dressed with 2½ cwt. basic super in August, 1926, and again in June, 1927; carrying-capacity in sheep and cattle more than doubled, and improved condition of stock very noticeable; manuring has already proved profitable. Paddock B: 1 cwt. each of basic super and 30-per-cent. potash at same dates as Paddock A. Though costing the same sum per acre, Paddock B has not shown nearly as much improvement in returns, and the profit is still doubtful.

A. Moore, Putake, Waitomo County.—Old bushfelling on clay and rubble at 1,800 ft. altitude. Pasture of English grasses with some danthonia. Top-dressed with 2 cwt. per acre of basic super during summer of 1926–27 (20s.). Increased capacity three-eighths of a ewe per acre, with great improvement in condition of stock. Manuring not yet recouped, but second dressing may prove profitable.

P. Naish, Mairoa, Waitomo County.—A seventeen-year-old bushfelling on crystalline limestone formation, mainly in danthonia. Top-dressed with 2 cwt. basic super in August, 1926. Increase during following summer, 120 wethers to 300. Improvement has since been maintained, but mainly in the shape of cattle. Sheep did not escape the usual attack of debility, probably due to parasitic infection, but the increase in wool alone nearly covers the cost of the manuring (15s. 6d. per acre).

Dimond Bros., Waitomo Caves.—A potash trial was included, the average dressing over the whole area being 180 lb. of basic super and 67 lb. of 30-per-cent. potash; this was in August, 1926, and June, 1927. Including a dressing of slag previously given, 25 acres have cost £60 for manure, and the increased value of stock grazed to November, 1927, was estimated to be £45. There is no doubt that the remaining £15

* Figures in parentheses refer to cost per acre; in all cases this amount includes freight, cartage, and all handling-costs.

will be made up this season, leaving a profit in the shape of a greatly improved paddock. Ewes carried in 1925, eighteen; 1926, twenty-five; 1927, forty. Fat lambs now obtained in place of stores.

A. C. Ronaldson, Awakino Road, Te Kuiti, Waitomo County.—Broken rhyolite country with thin loamy soil, originally in light bush. Before top-dressing, pasture had run out into Yorkshire fog and ragwort. Manuring has been accompanied by systematic crushing with cattle, 2 cwt. basic super in July, 1926 (16s.), and again in June, 1927 (14s.). Now winters eighty-five ewes and ten hoggets well, in place of forty done hard. This is an instance in which it has been possible to save the English grasses, which are now thoroughly revitalized. Top-dressing has shown a distinct profit.

N. J. B. Dougherty, Toi Toi, Ohura County.—Poor ridge of light shaly papa, felled out of light bush in 1913. English grasses nearly out and danthonia increasing rapidly. Top-dressed with 2 cwt. basic super in October, 1926, and again in May, 1927. Very little visible improvement, but one hundred ewes were wintered in 1927 as against fifty in 1926.

A. L. Ross, Matiere, Ohura County.—Good papa formation, but rather steep and shady, with a good deal of bracken-fern. Top-dressed with 2 cwt. basic super in July, 1926, and again in May, 1927. Wintering-capacity has been raised from one and a quarter to two ewes; 40 acres also wintered eleven dairy cows in good order. Manuring has probably paid.

W. S. Currie, Tatu, Ohura County.—Twenty-year-old bushfelling on papa and sandstone, badly reverted to bracken in places. Top-dressed with 3 cwt. super and slag in August, 1925, again in June, 1926 (half paddock only), and again in May, 1927. Total cost per acre, £3. Paddock has not been properly stocked, and manure sown in fern has been useless; but the clean grass has improved remarkably, and the whole paddock has increased in capacity from one ewe to two ewes per acre.

J. F. Waldegrave, Kaitieke.—Old bushfelling on rubble and papa; danthonia dominant in pasture; 15 acres flat (pumice), 15 acres sunny faces, and 40 acres shady. The two latter areas were given 2 cwt. basic super in September, 1926, and the shady portion a further 2 cwt. in June, 1927. The manure so far has not drawn the stock back on to the shady country. The whole paddock has cost £1 an acre for manure, and the increase is estimated at half a ewe per acre; it also does lambs far better than previously.

T. H. Tylee, Upper Retaruke, Kaitieke County.—Twenty-year-old bushfelling on steep, inferior papa formation. Top-dressed with 2 cwt. basic super in August, 1926 (17s. 10d.), and again in June, 1927 (16s.). So far there has been no significant improvement in carrying-capacity, but the danthonia has been greatly strengthened and the piripiri (hutiwai) nearly eliminated. The area should do well this winter.

Treacey and Son, Upper Retaruke, Kaitieke County.—Better-quality land and rather easier. Still holding a good proportion of English grasses, though danthonia has increased remarkably. Top-dressed with 2 cwt. basic super in August, 1926, and again in June, 1927. Wintering-capacity has increased from seventy to ninety-seven ewes; both lambs

and wethers now fatten well, and there is reasonable prospect of the outlay proving profitable.

Comparative Manurial Trials.

Although basic super was selected as the ideal fertilizer for hill-country use, and though there has been no reason to alter this decision as far as average conditions go, a few small comparative plots were also laid down, with the following results :—

K. A. W. Mackenzie, Oparau.—A dressing of 4 cwt. basic super per acre has not appeared to be any quicker in action than 2 cwt., though it shows some superiority now. Eighteen shillings' worth per acre of 30-per-cent. potash gave very little response, but 18s. worth of mixed potash and basic super was nearly as good as 18s. worth of straight basic super.

A. Moore, Waitomo Caves.—It was found that 4 cwt. basic super per acre was better than 2 cwt., but not 100 per cent. better so far; 6 cwt. not much better than 4 cwt. A dressing of 2 cwt. 30-per-cent. potash per acre showed good appearance at first, but has not the bottom of the supered area; potash in addition to the super is not markedly superior to super only.

Tynan Bros., Te Anga.—Straight basic super has given decidedly better results than the same cash value of basic super and 30-per-cent. potash. Small plots of various potash manures on adjoining land have given a negative result.

P. Naish, Mairoa.—A dressing of 4 cwt. per acre of basic super so far not much in advance of 2 cwt.

Dimond Bros., Waitomo Caves.—Plots receiving potash in addition to the basic super at first appeared stronger in clover, but this has not been maintained, and it is doubtful whether the potash has paid.

P. C. Rose, Kiritehere.—Plots on good-quality clay formation, burnt and resown in 1924, have given the following results: 2½ cwt. per acre basic slag—rather the best throughout; 2½ cwt. basic super—nearly as good as slag; 2 cwt. 44/66 super plus 3 cwt. ground limestone—quite good; 1½ cwt. 44/46 super plus 1½ cwt. Nauru phosphate—fairly good; 1 cwt. basic super plus 1 cwt. 30-per-cent. potash—poor response, and badly grazed.

B. Budden, Honikiwi.—Response to all manures has been slow, probably owing to sodbound nature of turf; but slag has proved rather better than 44/46 super, and both better than Nauru.

Departmental Paddock, Te Kuiti.—Rather sodbound turf of paspalum, with some Chewings fescue and sweet vernal, on fair-quality semi-volcanic clay. Sown down in 1910, but unmanured till 1926. All plots have done fairly well, but 3 cwt. per acre of 44/46 super and 3 cwt. basic super have been slightly the best; 2 cwt. 44/46 super plus 1 cwt. 30-per-cent. potash comes next; then 2 cwt. 44/46 super plus 3 cwt. ground limestone with 3 cwt. basic slag about equal. Ground limestone alone, at 7 cwt. per acre, has given very little response.

N. J. B. Dougherty, Toi Toi.—Potash alone, and potash plus basic super are indistinguishable from the rest of the paddock, which in this case has shown very little visible response.

W. S. Currie, Ohura.—Two dressings of 3 cwt. each have been much superior to one only, but three dressings have so far not been much better

than two. Slag appears to be slightly better than either super or super and slag mixed, but there is no marked difference.

G. C. Hammond, Owhango, Kaitieke County.—Old and badly-grassed bushfelling on undulating country, the soil being a thin loam over float pumice of great depth. All plots have revealed great improvement, though the latter was slow at first. A dressing of 3 cwt. basic super has done well, and rather better than 3 cwt. 44/46 super; 2 cwt. 44/46 super plus 3 cwt. ground limestone ranks next, and 3 cwt. basic slag last. This seems to confirm the general experience of pumice-land farmers in this district that super or basic super is the most profitable manure.

Conclusions.

In submitting the following conclusions it is desired that they should in no way be regarded as final. Work of this nature must necessarily occupy some years, and with conditions in a district such as the King-country, varying very widely as regards soil, climate, pasture-composition, farm-management, and access, one can hardly do more in the scope of a single article than formulate general recommendations.

(1) *Cost of Top-dressing per Acre.*—Where straight phosphatic fertilizers are used, and the area is comparatively large and reasonably accessible, 2½ cwt. to 3 cwt. per acre can be sown for an inclusive cost of £1. Bad access, horse-packing, mixed fertilizers, and other local circumstances may increase this amount somewhat.

(2) *Influence of Soil.*—The loamy soils of volcanic origin that characterize the northern end of the King-country will, broadly speaking, respond well to phosphates, as also will the pumiceous soils to the south, and any papa or good-quality clay. The rubble and clay formation is rather slower to respond, and sandstone is the least promising of any. Any soil that has once been stirred by the plough responds quicker and better than surface-sown land.

(3) *Influence of Pasture-composition.*—An outstanding feature of these trials is the way in which danthonia thrives under top-dressing, and appears to give increased returns comparable with those obtained with the higher-grade grasses. It must be understood that in the vast majority of cases the danthonia is in no sense sodbound, but consists of comparatively young and vigorous plants coming in to take the place of the deteriorated English grasses. In some cases there has been an increase in cocksfoot and other English grasses, but generally the increased returns have been obtained from the danthonia. One of the most hopeful features is that it seems possible by means of top-dressing to create a healthy and productive danthonia-dominant turf which will require a minimum of crushing, fencing, and manuring. Brown-top also seems to respond well to manuring; in fact, a good sole of "hard" grasses is a far more promising subject for manuring than a mixture of weak English grasses, fog, and weeds.

(4) *Effect on Fern.*—Generally speaking, manure is wasted when sown in fern that is at all thick, though a half-and-half mixture of bracken and grass can often be top-dressed quite successfully. No amount of manure will make stock do work that fire should accomplish. Top-dressing helps materially to control piripiri, and is a potent agent in the replacement of the smaller weeds by white clover and danthonia.

(5) *Choice of Fertilizer.*—Phosphates of more or less immediate availability still appear to be the main factor, and constitute the most profitable form of manuring. Heavy clay and papa soils respond best to slag, but basic super is a sound general-purpose fertilizer that can be recommended in all cases. There is no objection to high-grade super, unless it is that on the lighter soils basic super seems slightly preferable, and on the heavier soils basic slag. Potash in general has not given decisive results. As regards nitrogenous manures, it is doubtful whether any hill country could bear the high cost.

Lime has not figured at all largely in the trials, as it was felt that in the light of general experience it was unlikely to give a return in any way commensurate with the high cost of handling, at any rate on country where the carrying-capacity can never be very great.

(6) *Amount of Fertilizer per Acre.*—At present there is no evidence that heavier dressings than 3 cwt. per acre, given two years in succession, would be profitable. Observation rather supports the theory that old surface-sown country cannot at once make use of any large quantity of fertilizer, and that it is best to spread the amount over two or three dressings. Possibly 2 cwt. is too low, the optimum quantity being about 3 cwt. At any rate, one thing is fairly certain—that the second dressing usually brings the most effective result, and that it pays better to manure a given area thoroughly than to dress a fresh area each year.

(7) *Profit or Loss.*—On this point it is impossible to be explicit. Generally speaking, land of comparatively good quality, with a more or less closed sole of grass, that is carrying upwards of a ewe to the acre, will pay well enough, though possibly not for a year or two. Below one sheep to the acre there is a strong probability of a loss on the operation, unless the farmer is satisfied that a good proportion of the sown grasses still survive.

Farmers on the better class of land should make top-dressing a regular feature, starting with their best paddocks first and working back as funds permit. Those on the poorer land must aim principally at top-dressing one or two of their best paddocks into good conditioning areas, farming the rest of the holding on cheap lines with the "hard" grasses.

The writer desires to place on record an appreciation of the hearty co-operation extended by the numerous settlers on whose holdings these trials are being conducted. Thanks are also due to Auckland merchants who presented the fertilizers used on two of the farms, and to other members of the Fields Division who have from time to time assisted with the work.

Protection of Fruit-trees against Hares.—The hare is held to be a clean-feeding animal; consequently any mixture of a dirty or noxious nature is likely to serve for painting the trunks of young trees against its depredations. The most popular of such mixtures, on account of its simplicity, is one made of milk of lime and cow-dung. This should be made to the consistency of paint and applied with a brush.

DISEASES OF DAIRY COWS.

EXTENSION OF DEPARTMENT'S INVESTIGATIONAL WORK.

EXTENDED activities of the Department of Agriculture in connection with diseases of dairy cows have been announced by the Hon. O. J. Hawken, in the following statement :—

"During the last three years the veterinary staff of the Department of Agriculture has been engaged in special investigation work into certain diseases of dairy cows which are causing serious loss to dairy-farmers through decreased returns from their herds. These troubles—contagious abortion, failure to hold to the bull, mammitis, and vaginitis—are all associated with the reproductive and milk-yielding organs ; and while more or less intensive methods of dairy-farming naturally predispose cows to troubles of this kind, it has been realized that every effort must be made to assist farmers to overcome them to the fullest extent possible. The work already done by the investigators here has brought out some valuable information bearing directly upon the problems which have been faced ; but effective and reliable methods of preventive and curative treatment, especially methods capable of application by the dairy-farmers without too much expenditure of time, money, and labour, have yet to be discovered.

"During his recent trip abroad, Dr. Reakes, Director-General of the Department, devoted a great deal of his time to inquiries into what was known and what research work was being done in regard to this group of diseases. He found them to be more or less troublesome in all the countries he visited, and made a special point of discussing the subject with the most eminent authorities in Great Britain, the Continent of Europe, and South Africa. A great deal of information bearing on the question was obtained, but it is evident that the knowledge necessary to effectively cope with these troubles is not yet available.

"On Dr. Reakes's recommendation it has therefore been decided to further extend our investigation work in the Dominion, and to set aside two skilled veterinary officers—Mr. C. V. Dayus (now stationed at Hamilton) and Mr. W. M. Webster (now at Masterton) —to devote the whole of their time to special field investigations in connection with this group of diseases, in direct conjunction with Mr. C. S. M. Hopkirk, Officer in Charge, and Mr. D. A. Gill, Assistant Officer in Charge, of the Wallaceville Veterinary Laboratory. While these officers will specialize in the investigation, it will be supplemented by the general assistance of all the field veterinary and stock inspection staff of the Department. All the four officers mentioned have for the last three years been concentrating as much as possible upon the work in question, and thus already have a special knowledge of it ; hence it is hoped that the more systematic and wider research now being initiated may bring about more knowledge of these difficult troubles, and enable better methods of preventive and curative treatment to be found. The information obtained by Dr. Reakes regarding methods being used in investigation work in

other countries, especially in Denmark and South Africa, will be utilized to the fullest extent, and every advantage will be taken of the personal relations he established with scientists overseas who are working at the same problems for the interchange of views upon the progress of the work."

WHEAT VARIETY TRIALS IN CANTERBURY.

F. W. HILGENDORF, Lincoln College, and A. W. HUDSON, Fields Division, Department of Agriculture.

DURING the years 1913 to 1917 inclusive a variety trial of the then commonly grown wheats was conducted at Lincoln College. The methods employed lacked the refinements we now consider necessary in field experiments, but the results probably reached a considerable degree of accuracy. Table 1 shows these results as far as they concern the varieties still grown.

Table 1.—Variety Trial, 1913–17.

Variety.	Number of Trials.	Average of Five Years' Yields per Acre.	Increase or Decrease compared with Hunters.
		Bushels.	Bushels.
Hunter's	19	44·3	..
Solid-straw Tuscan	19	42·6	—1·7
Velvet	15	39·9	—4·4
White-straw Tuscan	30	36·6	—7·7

During some succeeding years the Department of Agriculture carried on at Ashburton trials of many new wheats in competition with the established varieties, and most of the introductions were gradually eliminated. By 1924 they were sufficiently reduced in number for the undertaking of more elaborate trials, and these were repeated in the three succeeding years. In 1927–28 a duplicate set of plots was laid down at Lincoln as a co-operative effort on the part of the College and the Department, and a survey of all the results is presented in Table 3.

In every case College Hunter's has been used as the standard; the paired drill-strip design has been followed; and the plots have been seven coulters wide, and of a length varying from 1½ to 3 chains. The replications have varied in number from twelve to twenty-eight, and "Student's" method has been used in computing the degree of significance of the results.

The same number of seeds to the acre have been sown in each variety. That every kind of wheat yields its optimum with the same spacing between plants is far from certain, but any definite and recordable plan of seeding is better than none at all.

The following table, which compares the estimated and actual number of seeds of the varieties sown in 1927–28, gives a measure of the accuracy of the drill used:—

Table 2.—Calculated Weights to give Equal Numbers of Seeds and actual Weights sown.

Variety.	Weight per Acre for equal Number of Seeds.	Actual Weight sown.
	lb.	lb.
College Hunter's	90·0	88·8
Major	107·4	106·1
Marquis	93·0	94·5
White-straw Tuscan	111·4	116·0
Red Fife	79·0	90·3
Velvet x Solid-straw Tuscan	87·0	101·0
Solid-straw Tuscan	106·0	105·0

The growth has in all cases been satisfactory for comparison purposes, differences due to soil and weed variations being fully compensated by the number and arrangement of the plots. The lower limit of significance in the difference of yield is about 1·5 bushels per acre. All the plots in any one year have been cut at the same stage of ripeness.

In the year 1927–28, when the crop at Ashburton was very heavy, it was found that White-straw Tuscan, Marquis, and Solid-straw Tuscan lodged in that order, but the degree of lodging was not such as to interfere with the cutting. Major and Hunter's stood up well. At Lincoln there was no lodging, but Marquis, Red Fife, and White-straw Tuscan were much more injured than the other varieties by the competition of a twitch that occurred in one part of the field used for the trial.

The average increases over the adjacent plot of Hunter's are shown in the following table. Differences that are not significant, but are due to chance variations only, are printed in italics, but all the differences are used to give the average result shown in the last column.

Table 3.—Average Yields, compared with Hunter's, of Wheats at Ashburton and Lincoln.

Figures in italics how non-significant differences. Each figure is the average of from twelve to twenty-eight different plots.

Variety.	Increase on Nearest Plots of Hunter's in Bushel per Acre.					
	Ashburton.				Lincoln, 1928.	Average.
	1925.	1926.	1927.	1928.		
Solid-straw Tuscan ..	..	*+1·1*	+7·1	+11·4	+7·4	+6·3
Velvet x Solid-straw Tuscan*	..	..	+3·3	†	+6·4	*+4·8*‡
Major	+5·5	−4·9	+8·6	+10·7	*−3·4*	*+3·3*
Goldberry	..	*+0·5*	*+2·4*	..	−4·0	*−0·4*
White-straw Tuscan ..	+9·0	−2·3	+3·6	−4·8	−12·6	*−1·4*
Velvet	..	*−0·6*	*+1·0*	..	−4·6	*−1·4*
Essex Conqueror ..	−5·0	*−0·1*	*−0·8*	..	−2·9	*−2·1*
Marquis	+2·9	−3·2	+2·8	−3·9	−12·9	*−2·9*
Red Fife	+5·7	−1·7	*+0·4*	−7·0	−14·0	*−3·3*
Yeoman II	..	..	−5·1	..	−11·8	*−7·9*
Hunter's average ..	35·3	14·1	37·8	69·0	64·0	..

* This is probably the Otago variety known as "Velvet Ear." † Ball smut so bad that plots were not threshed. ‡ Significance in last column calculated from Table XXV of "Tables for Statisticians," &c., by Karl Pearson, 2nd Edition, on the "Probability of Small Samples," &c. Essex and Yeoman approach significance.

FIG. 1. SHOWING ARRANGEMENT OF WHEAT VARIETY TRIAL PLOTS AT ASHBURTON EXPERIMENTAL FARM, SEASON 1927–28.

The dark strips on each side are Hunter's (the check variety); left centre —Red Fife; right centre—Velvet x Solid-straw Tuscan. Photo taken just before harvest.

FIG. 2. ANOTHER VIEW ON THE PLOTS.

Left—Hunter's; right—Solid-straw Tuscan. The latter lodged slightly in places.

The most striking feature in Table 3 as compared with Table 1 is the reversal of form in Solid-straw Tuscan. In the earlier trials it was 1·7 bushels per acre worse than Hunter's, and in the later series 6·3 bushels per acre better. This may be explained in two ways: (1) The Hunter's and Tuscan used in the first trials were from ordinary commercial seed, and in the later trials were pure strains. It may be that the College strain of Solid-straw Tuscan is a greater improvement than was realized. (2) The more likely explanation is that the seasons preceding the harvests of 1927 and 1928 were specially suited to Tuscan. They were both years of unusually liberal spring rainfall, which has certainly been reflected in the yields of Canterbury as a whole, and which may have been specially beneficial to Tuscan. At any rate, the lower yields of Tuscan in the earlier trial should make us cautious of fastening too much hope on the extraordinary yields shown in the later one.

The most striking feature in the later series of trials considered by itself is the difference between the yield of Major as grown at Ashburton and the College in 1928. At Lincoln Hunter's beat Major by 3·3 bushels per acre, while at Ashburton Major beat Hunter's by 10·7 bushels. This can have no other explanation than that the soil or season at Ashburton was more suitable to Major than it was at Lincoln, and indicates the need of conducting variety trials of wheats in many localities instead of in one centre only.

Another important point in the trials is that in 1926 most varieties yielded less than Hunter's, while in the years before and after Hunter's was beaten in nearly every trial. The spring before the harvest of 1926 was very dry, the ground at Ashburton got very hard, and the yield of every kind of wheat tried was below 15 bushels per acre. Hunter's showed a superiority under these hard conditions that it did not manifest under more favourable conditions.

Further trials in several localities have been arranged for the season 1928-29.

INTRODUCTION OF TUNG-OIL TREES.

TUNG-OIL is in demand by the paint and varnish trade, which has hitherto drawn its supplies from China. As the supplies are now limited and irregular it is desired to obtain them from a more reliable source. The Department of Agriculture has recently arranged for the introduction of the tung-oil tree, which is deciduous and grows with little care on poor, rough hill country. The nuts contain about 58 per cent. of oil. The tree is expected to do well on the gum-lands of North Auckland and the poorer hill country of Nelson Province and similar places.

The plains and river-terraces of Central Otago have been built up of the softer portions of the metamorphic schists, forming deep mica-schist soil which responds in a wonderful way to cultivation and irrigation. The fertility of the soil is well known, and appears to be the outcome of a happy combination of physical and chemical characteristics. The soils of Otago taken as a whole are decidedly above the average in quality, and this appears to be owing to the great extent of mica-schist exposed at the surface, the decomposition of which has supplied more or less directly almost all the soil in the province. The fertility of these mica-schist soils appears to be mainly due to the large amount of available phosphoric acid present in them.

FROST-PREVENTION FOR ORCHARDS.

HEATING EXPERIMENTS AND METHODS IN CENTRAL OTAGO.

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CENTRAL OTAGO has always been subject to periodical late spring frosts of varying intensity, occurring during the flowering or setting periods of deciduous fruits, and doing injury to a greater or lesser extent. In most cases only a slight and useful thinning of the crop takes place. At times, at longer intervals, frost occurs which involves a light crop of one or more classes of fruit. At rarer intervals there is a real "old man" frost which wipes out most of the fruit crops in the locality. Such a one happened in the spring of 1926. On 16th September, when the apricots were in bloom, there was a blizzard which accounted for the whole of the apricots of the district, with the exception of a few very small favoured spots. On 13th October a frost, varying in intensity in different parts of the district from 8° to 13° F., visited the Central and lower Central areas which destroyed nearly all the remainder of the stone-fruit and much of the apple crop.

Such a serious, though temporary, setback soon found expression among the sufferers, and at a meeting of the Central Otago Fruitgrowers' Association held in Alexandra it was decided to obtain all available information regarding methods and costs of frost-prevention. Having done this, it was still felt that as all the information collected (with the exception of a little from Hawke's Bay) was from the United States of America local tests were desirable to ascertain differences in climatic conditions and costs of appliances and materials. Accordingly the association approached the Government, and as a result a grant was made for such experiments through the Department of Agriculture.

The experiments were carried out in 1927, from August to November, and an account of the work is given in Part I of this article. In order to avoid unnecessary repetition, most of the material concerning the occurrence of frost, cost of preventive methods, description of appliances, &c., has been reserved for Part II, which will follow in due course. Some account will also be given of experiments carried out at Earnscleugh this year in the protection of the tomato crop against autumn frosts.

I.—THE 1927 EXPERIMENTS.

SITUATION OF EXPERIMENTAL PLOT.

After consultation with the Fruitgrowers' Association it was decided to carry out the experiments at the orchard of Mr. W. Bringans, of Alexandra. Our choice of site and owner proved to be a most happy one, for the former was admirably suited for the purpose, while nothing was too much trouble for Mr. Bringans and his family in their endeavours to render the experiments successful. The orchard is within half a mile of the centre of the Town of Alexandra, which is about 500 ft. above sea-level and situated in the fork formed by the confluence of the Manuherikia and Clutha (Molyneux) Rivers. The former comes in from the north-east and the latter from a north-westerly direction.

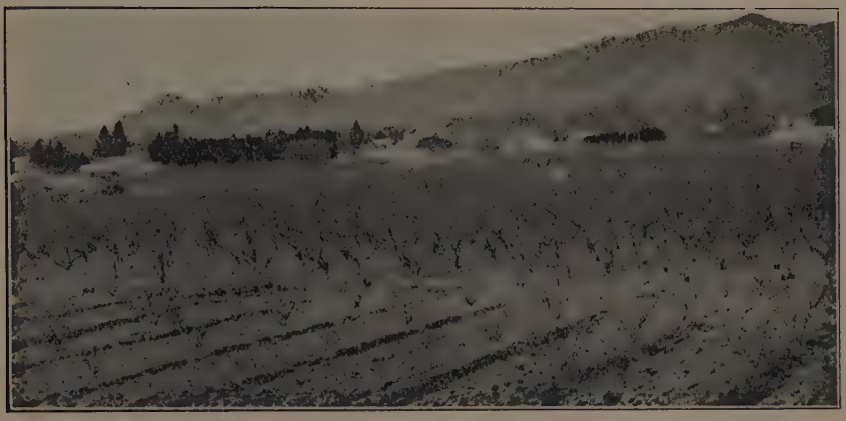

FIG. 1. VIEW OF PORTION OF MR. BRINGANS'S ORCHARD LOOKING TOWARDS HIS HOUSE (CENTRE).

The Crawford Hills show on the far left, and the closer hills are the Knobbies. Note the firepots on the experimental area.

[Photo by K. Glasgow.

FIG. 2. VIEW OF MR. BRINGANS'S ORCHARD LOOKING SOUTH.

Note the bank of tailings showing white between the trees and the hill. The Clutha River runs from right to left of the photo between the tailings and the hill beyond.

[Photo by F. Varney.

The plain round the town is bounded on the north by the Dunstan Range, with the Old Woman Rock (Leaning Rock) north-north-west, 5,325 ft. On the east is the Raggedy Range, rising to 2,514 ft., and the Crawford Hills, rising to 2,128 ft. On the south the Knobby Range comes right to the Manuherikia River at the back of the town, rising farther back to Cairn Hill (2,106 ft.). To the west lies the Old Man Range, with the Old Man Rock, 5,507 ft., south-west of the town.

The portion of Mr. Bringans's orchard selected for the experimental area (which will be referred to as the "plot") is surrounded by fruit-trees, and consists of 1 measured acre of fairly old (but well-cared-for)

stone-fruits (apricots, peaches, nectarines, and plums), and is invariably more or less frosted annually. The ground was in good condition and, at the time, in bare fallow. The trees are fairly large, are planted diagonally, 13 ft. between the rows, with the same distance apart in the rows, which run E.N.E. to W.S.W. There are no live shelter-belts adjacent to the orchard, but on the south-west side between it and the Clutha River is a wide belt of stone tailings, 20 ft. to 25 ft. high, thrown up at the time of the gold-dredging boom and completely blocking the orchard from the river. According to levels taken by Mr. K. Glasgow for the Scientific and Industrial Research Department, there is not more than 9 ft. of fall from the highest to the lowest part of the whole orchard.

Preliminary Tests.

Although the main experiment was to "deal with 1 acre of stone-fruit during the whole of the critical period," a number of preliminary tests were necessary to ascertain rate of burning of the oil, where and how many pots were likely to be necessary, to test the alarm, to become conversant with conditions, and generally to get the "hang" of things.

The following tests (1) to (5) were made to ascertain the length of time various pots would take to burn a quart of oil, and tests (6) to (8) to determine the value of a process suggested by Mr. G. Moir, of Dunedin.

	Time per Quart.	Equals, per Gallon.
(1) Benzine-tin cut down to 8 in. high, open top	30 min.	2 hrs.
(2) Benzine-tin cut down to 8 in. high, one-third of top covered	35 min.	2 hrs. 20 min.
(3) Benzine-tin, full size, quarter of top covered	38 min.	2 hrs. 32 min.
(4) Lard-pail design, open top	45 min.	3 hrs.
(5) Lard-pail design, with circular spider ..	65 min.	4 hrs. 20 min.

(6) An experiment was conducted in Mr. Bringans's orchard at Alexandra on 8th September, 1927. Into a ½ cwt. paint-drum (in which holes had been punched and wire grating and spiral placed), forwarded by Mr. Moir for the purpose, was placed 5 lb. of Linton coal in small lumps (according to his instructions). On this was poured a mixture consisting of ½ pint Pintsch oil and ½ pint used crank-case oil. It was lit easily with a match with a small explosion. The oil in the bottom of the drum burned for 20 minutes with a good flame. The fuel was nearly all burned out in two hours. It was found that a reasonable heat was not generated until half the coal had burned away, but during the second hour's burning a good heat resulted.

(7) Another experiment was carried out immediately after No. (6) in identically the same way, but using Coal Creek coal in place of Linton. The results were exactly the same.

(8) On the same day another experiment was commenced. The drum was filled with Coal Creek coal and treated in the same manner as in Nos. (6) and (7). This was allowed to stand with a lid on the top in the orchard until 28th October (seven weeks). Every effort was made to light it at the end of this period with matches, but without success. Liquid fire (benzine and kerosene as used in the torch for lighting oil-pots) was then poured on the coal, this being tried twice

FIG. 3. TYPES OF HEATERS USED IN THE EXPERIMENTS.

On left—8-quart (10 American quarts) Bolton Lard-pail Heater, with circular spider and lid imported from United States. On right—heater with triangular spider and lid suggested by the writer as suitable for local conditions and made by a Dunedin firm; the lid could be improved by being a little deeper.

FIG 4. LIGHTING-TORCHES.

On left—2-quart torch suggested by the writer as being suitable for local conditions and made by a Dunedin firm. This is fitted with asbestos covered with fine mesh brass gauze at point of spout, and similar gauze at base of spout, to prevent explosions. On right—6½-quart (2 American gallons) torch imported from United States, fitted with asbestos wick in point of spout, the latter squeezed in to hold it. Gauze is fitted at the base of the spout.

[*Photos by F. Varney.*

without success. Trials were then made several times to ignite the coal by pouring the liquid fire directly on the oil in the bottom of the drum, but in each instance the lighting-fuel burned out without igniting any of the fuel in the drum.

Following are the conclusions come to regarding Tests (6), (7), and (8):—

(*a*) The absolute necessity for the pots to be charged and ready for lighting for six to eight weeks in the orchard proves conclusively the unsuitability of Pintsch oil as a lighting-agent—evaporation having taken place in the meantime.

(*b*) The generation of heat immediately after lighting is far too slow—at any rate, with the lignite and brown coal used.

(*c*) Once lit, even if required for only an hour, the whole charge must be consumed, whereas with oil it can be immediately extinguished.

(*d*) The extra labour required for refilling as compared with oil is too big a tax.

(*e*) Being so highly volatile and inflammable, Pintsch oil is too dangerous for the average man to handle under the conditions prevailing when an orchard is being heated.

(*f*) The fact that Pintsch oil is a strong weed-killer makes its use in the orchard dangerous to the trees in the event of any being spilled. Moreover, the odour is very objectionable, and hangs about for a considerable time.

FIELD-TEST NO. I.

On the night of 8th August a small test in orchard-heating was carried out on the plot selected for the purpose in the presence of a few leading fruitgrowers. Four partially tested thermometers were placed as follows: A (check), 53 yards outside the plot to the north-east; B, inside the plot near the north-east corner; C, a little westward of the centre of the plot; D, near the south-east corner. All temperatures mentioned in this article, unless otherwise stated, were taken on partially covered stands (Fig. 6) at 4 ft. 6 in. from the ground, which is approximately the height in this and other countries at which standard temperatures are taken. Eighty benzine-tins were cut down about 2 in. and each provided with a spider or flame-spreader on the top, and a few 5-quart pots of the lard-pail type were put out. In each was placed ½ gallon of Tarakan fuel oil (B.I.O. Co.) having a specific gravity of 0·944 (equal to 237 gallons per ton weight). This oil was used throughout the experiments. The tins were evenly spaced between the rows of trees, those on the outside boundaries being placed a little closer. At 8.15 p.m. fifty tins were lit—namely, the whole of the outside row and every alternate ones besides. Each was allowed to be well lighted before the spider was put on. The lighting was done with a torch I had had made in Dunedin (Fig. 4, left), which holds 2 quarts, and the fuel used in which is equal parts of benzine and kerosene.

Following were the temperatures recorded, in degrees Fahrenheit:—

Table 1.

Time (p.m.)	8.15	8.45	9.15	10
Thermometers—				
A (check)	40	40	38	38
B	39	41	40	40
C	39	40	40	38
D	39	40	39	39

Unfortunately, the thermometers were not very accurate, but even so it appeared as if the temperature was raised from one to two degrees; it also felt as if the air was warmer inside than outside the area. After

9.15 p.m. the benzine-tins began to go out, and at 10 there was only an odd one alight. Although the experiment could by no means be called a good one, owing to the night not proving suitable, lessons were learned for future guidance. In particular it demonstrated the absolute futility of the benzine-tin as a commercial proposition in oil-burning for orchard-heating; the growers present were also entirely in agreement on this point. Even with a spider on, a gallon burns out in about two or three hours, leaving a pint, more or less, unburned. This is too expensive for the heat generated. The flame was very erratic, sometimes leaping up and at others not showing above the tins. Probably the shape is the trouble—square instead of round; moreover, benzine-tins are not now available in commercial quantities as they were formerly.

The few firepots of the lard-pail type, manufactured in Dunedin to my specifications, were an entirely different proposition. When we left the area at 10.30 p.m. they were all going strongly. The design was taken from illustrations of those used in America. The pot was a mass of flame which whirled round and ascended in a steady upright manner. The following are some of the results of the tests carried out with these pots, showing the rate of burning: Without spider, 1 quart took 45 minutes, equal to 3 hours per gallon; with circular spider, 1 quart took 65 minutes, equal to 4 hours 20 minutes per gallon. The pots appeared to burn too quickly without the spider, and with the circular spider (see Fig 3, on left-hand pot) there did not appear to be enough heat generated, and there was still ¾ pint left unburned with the latter, which with the spider removed took another 20 minutes to consume

It appeared, after numerous trials, that what was required was something between these two. After further experimenting I found that by cutting off the curve between the lugs of the spider and making an equilateral triangle (see Fig. 3, in front of right-hand pot) the following results were obtained: 1 quart took 1 hour 15 minutes to burn out, equal to 5 hours per gallon. To make sure, 1 gallon was lit up in the pot with this spider at 1 p.m., and at 5.45 p.m. it was still burning with 1 in. of oil still left in the bottom. Seeing that the heat weakens as the oil gets near the bottom, it appeared as if the 5-quart pot with the triangular spider should be burned for four hours, then with the spider removed there would be still left at least half an hour of good burning, thus giving a total good heating of at least four hours and a half.

As already stated, the growers present, like myself, condemned the benzine-tin, but were so taken with the 5-quart pot that the Central Otago Fruitgrowers' Association promptly decided to purchase eighty of these pots and triangular spiders, to be manufactured in Dunedin, and to be at the Department's disposal for our experiments.

FIELD-TEST NO. 2.

On 18th August Dr. E. Marsden (Secretary, Scientific and Industrial Research Department), Dr. E. Kidson (Director, Dominion Meteorological Office), and Mr. R. B. Tennent (Instructor in Agriculture) arrived, bringing with them a number of reliable tested minimum thermometers. The following evening another field test was made in the presence of these gentlemen and a number of growers. There had been a fall of

snow on the hilltops the previous night, most of the day was overcast, and during the test the sky was almost wholly obscured. The conditions, therefore, were quite unsuited for the purpose and unfavourable for orchard-heating. In this test the benzine-tins were discarded and replaced by the pots (Fig. 3, right) loaned by the Fruitgrowers' Association. These were placed in eight rows running approximately east to west, and containing nine pots per row. Lighting was commenced at 8.35 p.m., the whole being lit in 8½ minutes. The thermometers were in the same position as in the previous test. Following are the temperatures recorded, from which it will be seen that the thermometers in the plot were kept consistently from two degrees upwards above the outside check thermometer "A":—

Table 2.

Time (p.m.) ..	8.30	8.35	8.55	9.5	9.15	9.25	9.35	9.45	10.5	10.15	10.20	10.30	10.45
Thermometers—													
A (check) ..	36·5	All pots lit.	36·2	37·6	37·4	37·4	37·0	36·4	36·3	36·2	All spiders off.	36·1	36·2
B	36·5		38·0	39·6	41·1	40·5	41·5	41·5	40·0	40·1		40·3	40·5
C	36·0		36·8	39·0	39·5	39·4	39·4	39·2	38·5	38·5		39·1	38·4
D	36·0		36·5	39·0	40·2	41·0	40·0	39·2	39·0	39·0		38·2	38·0
Wind light ..	S·E.	..	E.	E.	N.E.	N.	N.N.W.	N.W.	E.	S.E.	..	E.	N.E.
Sky	Mostly overcast						Completely overcast.						

FIELD-TEST NO. 3.

On the night of 27th August another heating experiment was carried out on the plot in the presence of a large number of growers, with apparently disappointing results. The day had been overcast and calm until late afternoon, when it cleared and a cold southerly wind sprang up, which gradually died down towards evening, and frost set in. The thermometers were placed somewhat differently than in previous tests. The check A (standard one) was in the same position as before; B, C, D, and E (untested ones) were placed respectively in the north-east, north-west, south-west, and south-east corners, two pots each way inside the plot. F (standard one) was placed practically in the centre of the plot. No thermometer was nearer than 13 ft. from a fire.

At 9.30 p.m. thirty-eight pots were lit as follows: Nine in the top (northern) row, five in the bottom one, and four in each of the other six rows. Just after 10.30 p.m. an additional twenty-one were lit—namely, none in the top row, four in the second, three in each of the next five rows, and two in the bottom row, making a total then alight of fifty-nine. At 11.15 p.m. the remainder were lit. The position of the lighted pots was then as follows: Top row, sixteen; second row, ten; third to eighth rows, nine each; with an additional six on the front (east), making a total of eighty-six fires. It must be noted, however, that of the twenty-seven pots lit at 11.15 seven were in the top row and six across the front, thus leaving only fourteen additional inside ones.

The temperatures, and conditions of sky and wind, are shown in Table 3. Although it was practically calm outside the area, there appeared to be a drift from the directions indicated, but between the readings the wind might occasionally be from anywhere for very brief periods.

Table 3.

Time (p.m.) ..	9.25	9.30	10	10.30	10.35	10.45	11	11.15	11.30	12	a.m. 12.30
Thermometer—											
A (check) ..	31·5		31·5	31·5		29·5	30·5		30·0	29·0	28·0
B.. ..	31·5		31·5	31·5		31·5	32·0		32·0	32·0	30·0
C.. ..	32·5	38 pots lit.	31·0	31·0	Additional 21 pots lit.	30·0	31·0	Additional 27 pots lit.	31·0	30·0	28·0
D.. ..	33·0		32·5	32·5		31·0	32·0		32·0	30·5	30·0
E.. ..	32·0		31·5	31·5		31·5	31·0		30·0	30·0	29·0
F.. ..	32·0		31·5	31·5		30·0	31·5		32·5	31·0	30·0
Wind calm ..	S. drift	..	S.E. drift	S.E. drift	..	S.E. drift	S.S.E. drift	..	S.S.E. drift	S.E. drift	S.S.E. drift
Sky	Clear throughout the night.										

It will be noted that on the sides from which Mr. Bringans considered the frost comes—namely, north and east—additional protection was given, but, unfortunately, the drift came from the other quarter (south-east); one side (the front or east) only having the extra pots. Had additional ones been available for the bottom (south) row, possibly an improvement might have been effected.

Owing to the day being overcast, the soil would receive very little heat from the sun's radiation. I presumed, therefore, that inversion would be very poor. The result of this test was submitted to Dr. Kidson, and his reply may be quoted as follows:—

> From the experience on the two nights when heating was carried out and what was told us in Alexandra, I should anticipate that the drifts during frosts at Mr. Bringans's orchard would generally be from the south and south-east. Your extra pots seem to have been of little value on 27th August. It is not surprising that the readings should be rather erratic on the edge of the area; the air-currents caused by the fires themselves might be responsible for that. The amount of heating was, however, disappointing, especially at the centre of the area. One would not have expected the conditions to be good owing to the facts that the sky was clouded until late afternoon and that there was a southerly breeze for some time thereafter. There would not be a marked inversion, probably, even by the time you finished your heating. It must be remembered that the coldest time is just around the dawn. Had you continued heating until that time the temperature of the orchard might have been kept considerably above that outside. On that Saturday night the minimum temperature fell to 21·2° F. at Ophir. I would suggest that you commence the next experiment at 2 or 3 a.m. I do not understand why we had such good effects on the night we were in Alexandra. There must have been some luck about it. There was one difference in the weather on the two occasions which might be significant: On the night we were there the upper winds were from the south-east; on 27th August they were probably from the west; and, in any case, there was little time for things to settle down, since pressure-changes were rapid. The westerlies may have sent down large masses of cold air from the mountain-tops. It is such points that have to be learnt from local experience.

FIELD-TEST NO. 4.

On 31st August Mr. K. Glasgow arrived under engagement from the Research Department to take levels in Mr. Bringans's orchard, and generally to take weather observations, &c. He was present and assisted me at the test held on 17th September, and I am indebted to him for his help and for recording temperatures.

Additional gear had now come to hand, consisting of fifty Bolton lard-pail heaters (as illustrated), one torch, and four Tycos minimum thermometers, all from America. Apart from these there were also standard thermometers and thermograph (self-registering thermometer) loaned by the Meteorological Office. These extra heaters and thermometers enabled me to put into operation a rearrangement in their positions which experience in earlier tests had suggested. Fig. 5 shows the approximate arrangement.

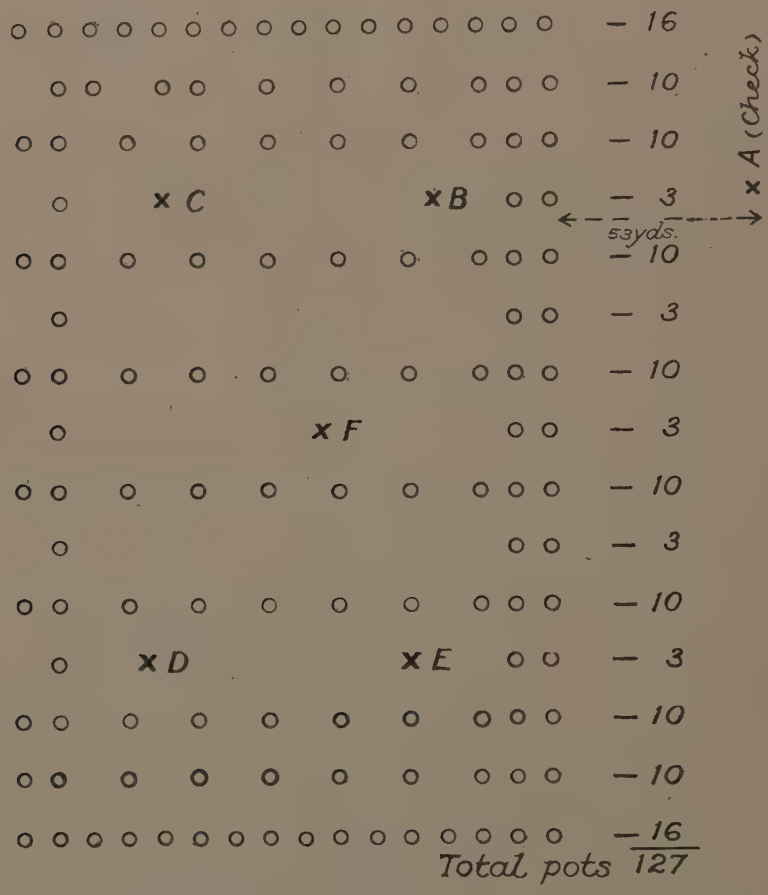

FIG. 5. DIAGRAM SHOWING APPROXIMATE ARRANGEMENT OF POTS AND THERMOMETERS ON MORNING OF 17TH SEPTEMBER.

Circles (O) denote firepots; crosses (X) denote thermometers.

The Tycos frost alarm was placed in Mr. Bringans's bedroom; the thermometer connected therewith by insulated wires is set to ring at 32° F., and was hung on a branch 3 ft. from the ground. Arrangements

were made with the Telephone Exchange to connect, after office hours, the telephone at Mr. Bringans's house with an extension telephone in my bedroom. On the morning of 17th September the frost alarm went off, and Mr. Bringans immediately rang me up. Accompanied by Mr. Glasgow I proceeded to the orchard, took temperatures, and immediately (2.55 a.m.) lit sixty-seven pots, the operation of lighting taking seven minutes. The first ones to be lit were approximately every alternate pot on the east and south sides, and then alternate ones throughout the plot.

The temperatures, condition of sky, wind, &c., are presented in the following table :—

FIG. 6. TYCOS FROST ALARM AND APPARATUS.

On left—frost alarm, which is usually placed in the bedroom and has only been put in this position for photographing. On right—thermometer screen, showing thermometer just below upraised lid. Low down on post is thermometer which causes bell to ring in bedroom when temperature of 32° F. is reached. Connecting-wires can be seen on the right.

Table 4.

Time (a.m.)		2.55	3.30	4	4.30	5.30	6	6.30	7
Number of pots lit		67	67	67	90	97	104	104	0
Thermometers—								Sunrise.	
A	Outside checks.	32·0	33·0	34·5	32·5	29·5	29·5	29·2	30·8
Ag		31·5	30·0	30·0	29·8	29·0	29·5	29·8	31·0
A/10		34·0	34·5	..	32·8	30·0	30·2	30·2	32·2
A/14		33·0	34·5	..	33·0	31·0	31·2	31·0	32·5
B		33·0	35·0	..	34·0	30·0	31·0	31·0	33·0
C		31·5	33·5	..	34·5	30·5	32·0	32·0	32·5
D		33·5	37·0	..	34·0	32·2	32·0	32·0	32·5
E		33·1	37·3	..	38·2	33·0	32·0	33·0	35·0
F		32·2	32·0	36·5	35·7	32·2	32·5	32·0	32·8
Fg		31·5	32·0	34·0	33·0	30·0	31·0	31·0	32·0
F/10		33·2	35·5	..	35·0	32·0	31·5	31·5	32·5
F/14		32·5	35·5	..	35·0	32·0	31·5	32·0	33·0
Check (No. 5)		32·0	31·5	31·0	30·0	28·0	29·0	30·0	30·2
Wind—Calm		E.	S.E.	Nil	N.W.	N.W.	N.E.	E.	E.
Sky		Clear.							

FIG. 7. GENERAL VIEW OF EXPERIMENTAL PLOT, SHOWING ARRANGEMENT OF POTS. [*Photo by K. Glasgow.*

Temperatures were also taken at different altitudes at stations A (outside check) and F (centre of plot), and are shown in the table as—Ground level, Ag and Fg; 10 ft. level, A/10 and F/10; and at the 14 ft. level as A/14 and F/14. An additional station, known as No. 5, was created as another check at a distance of 100 yards to the south-south-east of the plot. The latter was found useful on the present occasion, as the drift of air at one time for a short period veering round from the south-east to the north-west blew the warm air towards the A (check) thermometer and caused it to rise, as shown in the temperature table.

All the fires were put out at 6.45 a.m., with the exception of two rows on the eastern side. The spiders were taken off these, and they

FIG. 8. VIEW OF EXPERIMENTAL PLOT AT 3.30 A.M. ON 17TH SEPTEMBER, SHOWING POTS ALIGHT.

[*Photo by K. Glasgow.*

were left alight for another half-hour to allow of a smoke screen to be formed as a protection from the rising sun, as according to some authorities much of the damage is done by the sudden rise of temperature after sunrise. This protective screen is shown in Fig. 9.

There is no doubt as to the success of this trial, and the conditions more nearly approached those likely to be met with when heating is necessary to protect the crop. The blossoms of apricots were at this time about one-third out. When the fires were lighted about 3 a.m. the temperature had fallen to 32° F. Inside the heated area it was not allowed to go below this; it was kept at from 3° to 6° above the outside check thermometers, the lowest reading of the latter being 28° F. A very noticeable feature, and one which I think will appeal to growers more than the actual temperatures shown, is a comparison of the amount of hoar-frost showing on the trees inside and outside the plot.

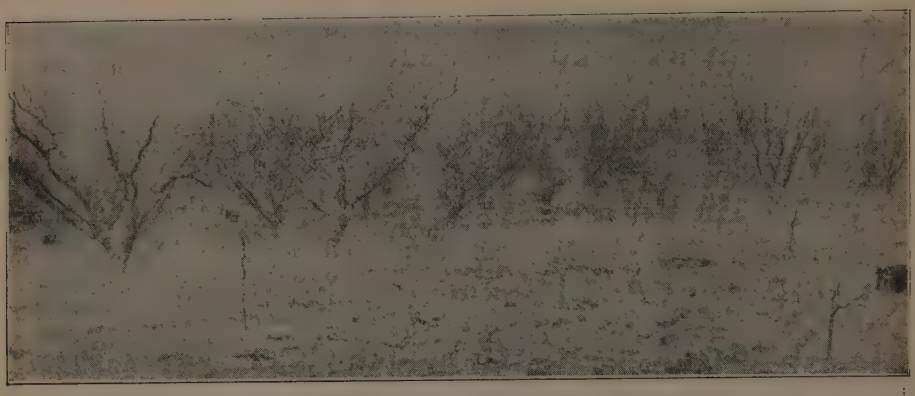

FIG. 9. VIEW OF ORCHARD BEFORE SUNRISE ON 17TH SEPTEMBER.
Note heavy pall of smoke intended to act as a protective smudge against the rising sun.
[*Photo by K. Glasgow.*

All the trees outside the heated area carried a heavy layer of hoar-frost, some adjacent to but outside the plot even having miniature icicles on them where, through the change of air-current, the frost had been melted and again frozen. On the other hand, there was no frost on the trees in the plot, with the exception of one low-spreading apricot which had a light coating on the tops of the lower limbs.

Protective Experiments.

EXPERIMENT NO. 1.

On 4th October there was a light shower in Alexandra, with a light fall of snow on the ranges, and overcast sky most of the day. On the following morning at 1.5 a.m. the alarm went off. Lighting of pots commenced at 2 a.m., and within ten minutes eighty pots were alight. At 5 a.m. another twenty were lighted (sixteen on the eastern side and four on the south). At 6.10 a.m. a few fires were going out here and there, but were not relit; all were extinguished at 6.30 a.m. It was found at times, owing to sooting up, that it was necessary to give the

Table 5.

Time (a.m.)	1.45	2.10	2.45	3.15	3.45	4.15	4.45	5	5.15	5.45	6.10	6.15	6.30	6.45
Number of pots lit	..	80	80	80	80	80	80	100	100	100	100	100	Nil	Nil
Thermometers—											Sunrise.			
A ..	31·0	..	32·0	32·7	32·5	31·5	30·5	..	30·5	30·0	..	31·0	..	32·0
Ag ..	..	..	27·0	27·5	26·0	25·5	25·0	..	25·3	27 0	..	28·0	..	31·3
A/14 ..	..	..	32·0	32·7	33·0	32·5	31·5	..	32·0	32·5	..	32·0	..	35·0
B ..	32 0	..	32·5	34·0	32·5	33·0	31·0	..	32·0	32·5	..	33·5	..	39·5
C ..	31·0	..	33·0	34·0	34·0	33·0	32·0	..	32 0	32·0	..	32·5	..	34·0
D ..	32·0	..	32 5	34·5	34·0	33 8	32·0	..	33·0	31·8	..	33·0	..	35·0
E ..	31·0	..	34·5	35·0	34·0	33·6	32·5	..	36·5	36·8	..	37·0	..	35·8
F ..	32 0	...	34·1	35 0	34·5	34·0	33·0	..	33·0	32·5	..	33·0	..	34·0
Fg ..	31·0	..	32·0	33 6	32·5	31·8	31·0	..	31·8	31·8	..	32·0	..	35·5
Wind drift..	S.	N.E.	N.E.	E.	E.	S.E.	N.W.	..	E.	S.W.	S.	E.	..	..
Sky ..	Clear								Light cloud in E.	Cloud and smoke obscuring E.				

spiders a little raking with a stick to allow of better combustion and greater heat, this being more noticeable with the American pots with circular spiders. The alarm thermometer was lowered in this experiment to 2 ft. above the ground for safety's sake. The position of the pots was also slightly altered, as shown in Fig. 10, and they were left in this position for all later tests.

Temperatures, condition of sky, wind, &c., are shown in Table 5. From this record it will be noted that the temperatures were again raised several degrees above the danger-point.

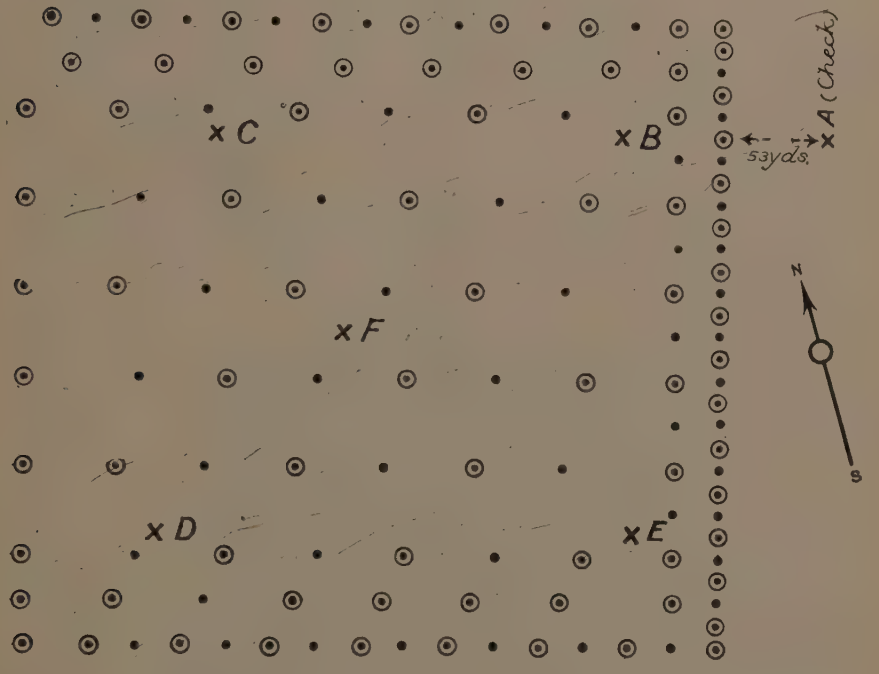

FIG. 10. DIAGRAM SHOWING POSITION OF FIREPOTS IN ALL THE PROTECTIVE EXPERIMENTS.

Dots indicate firepots; those marked with circle ⊙ would approximately be the first lighted.

EXPERIMENT NO. 2.

On 24th October the wind was southerly and bitterly cold, with scattered showers on the flats and snow low down on the hills, resulting in the alarm ringing at 2.30 a.m. on the 25th. As the temperature rose for a while after this, fires were not lit until it again commenced to recede—namely, at 4 a.m., when fifty-eight were ignited. As these were not holding the temperature an additional thirty-eight were lit at 4.45 a.m. with good results. All fires were extinguished at 5.45 a.m.

Temperatures, condition of sky, wind, &c., were as follows :—

Table 6.

Time (a.m.) ..	3	3.20	3.45	4	4.15	4.30	4.45	5	5.15	5.20	5.45
Number of pots lit	..	..	..	58	58	58	96	96	96	96	Nil
Thermometers—									Sunrise.		
A ..	29·0	31·0	30·0	..	30·0	29·0	..	29·7	..	29·0	..
Ag ..	..	27·0	..	..	27·5	..	..	..	..	..	..
B ..	..	..	27·0	..	30·0	28·5	..	30·0	..	32·0	..
C ..	..	..	28·0	..	28·0	28·0	..	27·0	..	30·0	..
D ..	..	..	28·0	..	28·0	28·0	..	29·0	..	30·2	..
E ..	..	..	26·0	..	30·0	29·0	..	29·5	..	31·5	..
F ..	..	32·5	31·0	..	31·0	31·0	..	32·0	..	32·6	..
Wind, drift ..	N.W.	W.	E.	E.	N.	N.	W.	E.	N.	N.	..
Sky ..	Clear	..	..	..	..			Clouding in E.			

The condition of the trees at this date (25th October) was as follows : Apples—blossoms nearly off ; pears—blossoms all off ; quinces—blossoms commencing to fall ; apricots—well formed, calyces all off ; peaches and nectarines—fruit formed and one-third exposed, calyces loosening ; plums—about the same as peaches, with a few calyces right off ; cherries—calyces practically all off.

This frost did quite a considerable amount of damage in the district, in the lower-lying susceptible orchards, to all stone-fruits and some pears, quinces, and apples, especially Delicious. There was no damage done in the heated areas either at the experimental plot or elsewhere. The following notes from two other orchardists who fired on this occasion are interesting. Mr. J. R. Laing, Earnscleugh, states :—

The piece of ground is on a level with the highest part of the orchard, and is open on the north and east sides, protection being given from other trees on the west and south sides. At 3 a.m. on the morning of 25th October the thermometer registered 30° F. At 4 a.m. it had gone down to 29° F. The sky being clear I decided to light up, starting on the west side, and worked down the north side, then lit back to the west side again. All were lit by 4.15 a.m., and temperature in middle of block was 28° F. At 4.25 it was 29°, with the wind south-west and the sky clouding over. At 4.35 drift from west with temperature at 28°. At 4.40 drift from north, temperature 31°, with heavy clouds in the east, possibly the result of firing at Alexandra. At 5.10 drift from south-west and steady, with sky clearing slightly and temperature 30¼°. All fires put out at 5.40, the temperature being 31°, with no drift, and the sky cloudy in the east. I had no outside record, as I had only one thermometer in working-order. The block fired consisted of 1¼ acres of apricots (180 trees). One hundred heaters were used, and they were placed in a double row round the north-west and south sides, the east side had a single row, and the balance were in alternate rows from west to east. Burning-time was about one hour and a half, and the oil used cost about £1 8s. On examining the trees I found that no damage was done on the west, north, and east sides. On the other hand, the trees on the south side, where the principal drift was from, were frosted about 4 ft. from the ground, and a double row of heaters on that side would have saved the crop. The heaters were taken in a fortnight after that, and a frost coming later undid the efforts of the 25th.

Mr. J. H. Hinton, Earnscleugh, reports :—

A block of greengages with a heavy crop of fruit was selected for the purpose. The trees are 19 ft. apart, and the block consisted of seven rows with seventeen trees in each row. Ninety-six pots were distributed over this area—viz., six rows

[illegible] on the [illegible] [illegible] [illegible]

EXPERIMENT NO. 3.

After a spell of fine weather a change came on 10th November, most of the day being overcast, with a cold west to south wind blowing. That night snow fell on both the Old Man and Old Woman Ranges. The following day was bitterly cold, the wind being from the south; there was rain on the flats, and snow was falling on the Old Man Range. At 9 a.m. (11th November) the humidity was almost 100 per cent. and the temperature 47° F. The cold southerly continued until the middle of the afternoon, then died down, and the sun appeared. At 7 p.m. the sky was almost clear, the temperature being 50° F.; the maximum temperature for the day was 55° F. At 11 p.m. the temperature had lowered to 38° F., with prospects of a frost. However, the lowest temperature reached that night was 32·4° F.; this being at 1 a.m. on the 12th, after which the sky clouded over and the temperature rose. At 9 a.m. on the 12th the temperature was 39° F., and snow was falling on both ranges, with light rain on the flats. In the afternoon the weather warmed, resulting in the maximum temperature for the day being 64·7° F. At 7.20 p.m. the temperature was 59° F., the sky was mostly overcast, with low thick clouds in the west, but very thin elsewhere. The 13th was bitterly cold, with snow falling on the ranges, and most of the day and evening there was a fairly strong southerly blowing.

The temperatures hitherto quoted in this section (Experiment 3) all refer to those taken in the standard Stevenson screen (Fig. 11), and to co-ordinate them with outside temperatures under the ordinary 4 ft. 6 in. shelters (Fig. 6) they should be reduced from two and a half to four degrees. Also it should be pointed out that throughout this article standard times only are referred to.

As was expected, the frost alarm went off on the morning of 14th November. It rang at 3.45 a.m., the temperature at thermometer A reading 30·5° F. a few moments later.

Following are the temperatures, condition of sky, wind, &c.:—

Table 7.

Time (a.m.) ..	3.45	4	4.12	4.45	5.5	5.15	5.55	6
Number of pots lit ..	..	..	100	100	100	100	100	..
Thermometers—	Alarm rang.					Sunrise.		
A } Outside checks	30·5	28·0	..	27·5	28·8	29·0	33·0	..
Ag } Outside checks	..	25·0	..	24·5	28·0	26·0	..	..
B	..	29·0	..	32·0	34·0	..	37·0	..
C	..	29·0	..	32·0	33·0	..	..	..
D	..	28·5	..	32·8	35·0	..	..	..
E	..	28·0	..	33·5	34·5	..	..	..
F	30·2	28·5	..	33·0	34·8	..	37·0	..
Fg	..	..	..	32·3	32·0	..	..	..
Wind, calm ..	..	S.E.	N.E.	N.E.	N.E.	N.E.	N.E.	..
Sky	Clear.							

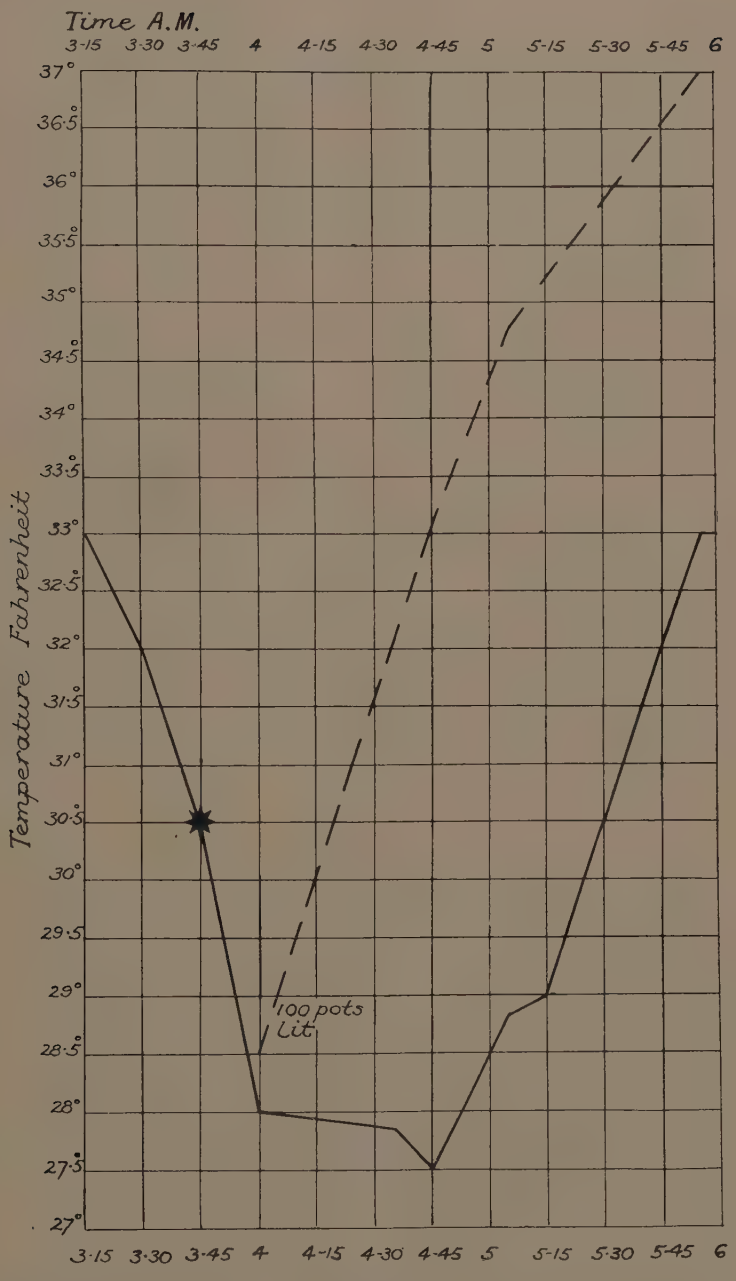

FIG. 12. GRAPH SHOWING TEMPERATURE MOVEMENTS IN PROTECTIVE EXPERIMENT NO. 3.

Lower (unbroken) line shows temperatures from 3.15 to 5.55 a.m. on 14th November, at Station A in Mr. Bringans's orchard. Broken line shows temperature in heated area. Star denotes time alarm rang. Note the sudden rise in temperature after lighting 100 pots between 4 and 4.12 a.m.

From Table 7 it will be noted that the temperature dropped two and a half degrees between 3.45 a.m. and 4 a.m. — namely, between the time the alarm rang and just prior to lighting up, also between 1.45 a.m. and 4.45 a.m. (three hours) it dropped ten degrees. This proved to be a dry "black" frost, which no doubt accounted for the sudden drop in temperature. The alarm thermometer had been placed for all these protective experiments, including this one, at a height of 2 ft. above the ground, and it had been found that at this height the alarm rang sufficiently early to give one ample time to reach the orchard and light up before the temperature had dropped too low; indeed, as will be seen from the reports of earlier experiments, one had to wait quite a while before lighting up.

With the phenomenally sudden fall in temperature experienced on this occasion it was evidently into the danger-zone before the fires were lit, for considerable injury was done by the frost, and this in spite of the fact that Mr. Bringans rang me up at my home immediately the alarm rang and that one hundred pots were lit by me within half an hour of that time. Had the alarm rung half an hour earlier the pots would have been lit by 3.45 a.m., when the temperature was only 30·5° F. It is quite evident that the injury was done before the fires were lit, because as the graph (Fig. 12) shows the temperatures were raised well above the danger-point in a very short space of time after lighting up. This view is further strengthened by the fact that Mr. Bringans, who also had some pots of his own, did not wait my arrival, but commenced firing his immediately, and there was certainly less damage on the portion he first fired. A "black" frost of this description is, fortunately, of very rare occurrence in this district; and, although firing did not entirely prevent injury, it must be admitted that its occurrence while experiments were being conducted was most opportune, for the lesson learned is a most valuable one.

EXPERIMENT NO. 4.

In view of the experience gained in the preceding experiment the alarm thermometer was placed still farther out in the open and lowered 3 in., making the mercury 1 ft. 9 in. above the ground. This had the desired result in causing the alarm to ring sooner than on previous occasions. It will have been noted that on the morning of the previous day the temperature at "A" thermometer was 30·5° F. as soon as it could be read after the alarm went off, whereas on this morning (15th November) the temperature at "A" registered 31·5° F. when the alarm rang, thus giving us longer time in which to get our fires going.

As there was every evidence of another frost, everything had been placed in readiness after the previous experiment. The alarm rang at 2.45 a.m. (15th November), but owing to some defect Mr. Bringans was unable to connect with me by telephone. He watched the temperatures for a while and then came for me at 3.30 a.m. The pots were lit at 4.15 a.m., and all were extinguished by 5.30 a.m. It was noticed that the trees outside the fired area were very white with hoar-frost; those within were mostly dry; a few were wet, but none had frost on them. The following table again demonstrates the fact that the temperature can be readily raised by firing.

Table 8.

Time (a.m.) ..	2.45	3.15	3.40	3.55	4.5	4.15	4.30	4.40	5.10	5.30
Number of pots lit	..	..	..	..	..	66	66	66	66	..
Thermometers—	Alarm rang.								Sunrise.	
A } Outside	31·5	30·5	32·0	31·0	30·5	30·0	30·2	30·0	30·0	..
Ag } check	..	28·0	30·0	29·0	28·0	28·0	28·5	..	29·5	..
B	..	..	..	..	..	30·8	..	33·0	34·2	..
C	..	..	..	..	..	30·0	..	32·0	32·2	..
D	..	..	..	..	..	30·0	..	33·5	34·0	..
E	..	..	..	..	..	30·5	..	34·6	35·5	..
F	..	..	..	..	..	30·5	33·2	33·8	34·0	..
Wind almost calm	..	..	..	..	S.E.	S.E.	N.E.	N.E.	S.	..
Sky	Few thin clouds.									

A DECEMBER FROST.

Shortly after this experiment, prospects of further frosts appearing to have vanished, all pots and other apparatus were removed and stored. This was only decided upon after very careful consideration by Mr. Bringans and myself. He considered that if another light frost came less damage would be done by it than by the neglect of cultivation and irrigation. These operations were impossible with the pots in position without a considerable amount of labour in moving them about and replacing them. Unfortunately, the exceptional happened, and another frost of six degrees was registered on the morning of 8th December, which did quite an appreciable amount of damage in some orchards.

I cannot close this part of the article without acknowledging the assistance and courtesy extended to me during these investigations. Among the foremost are officers of the Horticulture and Fields Divisions of the Department of Agriculture. Thanks are extended to Dr. Marsden and Dr. Kidson for much advice and the loan of valuable instruments, which rendered accurate readings possible; to the Otago Central Fruitgrowers' Association, both as a body and individually; to Mr. A. S. Duff for many nights' assistance in taking temperatures, &c.; to Mr. R. B. Tennent, Mr. K. Glasgow, and many others. The assistance and courtesies extended to me by Mr. Bringans and his family I have already mentioned; without their valued co-operation the work would have been far more difficult than it has been.

(To be continued.)

The Ragwort Moth.—The Noxious Weeds Control Committee of the Research Council has recommended that an open permit be now granted for the liberation of the ragwort moth (*Tyria jacobaea*), and that increasing supplies of this insect be imported, so that it may be extensively liberated in ragwort-infested areas next season.

IRON-STARVATION (BUSH SICKNESS) IN STOCK.

MORE FARMERS' EXPERIENCES WITH TREATMENT.

B. C. ASTON, F.N.Z.Inst., Chief Chemist, Department of Agriculture.

SINCE the publication of the article on Iron-starvation in last month's *Journal* further satisfactory replies have been received from farmers in the affected districts regarding their experiences with iron-ammonium citrate, together with other practical points in the control of "bush sickness." A summary of these communications is given below. It may be noted that districts denominated by a letter used previously (see May *Journal*) are the same; where the letter is a new one the district has not been previously mentioned.

DISTRICT A.

Farmer "W" notes that it takes a fortnight to three weeks' treatment to effect a cure. He obtained good results in administering the scales to calves in their feed milk, enabling them to be reared. He finds that for cows the best method is to give the drug as a drench, as each animal then receives its proper dose. He also uses sulphate of iron in the drinking-water. He finds that the cost of this treatment is less than changing the stock to other districts, especially if the animals are taken in hand at the first sign of sickness. He has had no failures. He has also top-dressed his pastures with sulphate of iron, and given the cattle a lick composed of salt, bonemeal, and sulphate of iron.

Farmer "M" has used the iron scales as a drench for sick cows, and it has helped them to recover.

Farmer "G" found that for cows about a fortnight was the usual length of treatment required with the drug. Given as a drench after calving, he found it quite satisfactory. He finds that drenching is much cheaper and quite as effective as changing the cows to other districts. He has had no failures or bad effects, and finds that as a tonic iron-ammonium citrate is quite effective, that cows relish it, and that he can recommend it as a remedy for bush sickness.

Farmer "P" has had good results with a drench of 1½ oz. iron-ammonium citrate to 1½ pints of water, given once a day for eight days. He tried also sulphate of iron in the drinking-water, but did not notice any appreciable result. He and another farmer are of the opinion that good healthy change paddocks are the best for keeping stock healthy, although involving a higher cost. During the past season this farmer has not drenched with iron, but resorted to a lick of salt and bonemeal (equal parts) with about 1½ oz. of the iron scales. This is kept always before the animals, and with about two exceptions the stock have not shown any signs of sickness. The two exceptions were poor-constitutioned cows. He is top-dressing pretty heavily, which is improving matters. He remarks that if cows can be changed only during the off-season, as is the case with his farm, they need the iron lick to keep them healthy.

Farmer "D" has used the iron scales on sick cows, and finds a few weeks necessary to effect a cure. He has not had occasion to use any iron during the last two years. He finds that by top-dressing the paddocks with superphosphate and basic slag (the latter containing about 15 per cent. colloidal iron) and keeping the feed eaten down, the cows do not need a change as they did a few years ago. This, however, does not apply to sheep, as so far it is not possible to keep them in that locality any length of time before they begin to get sick.

DISTRICT H.

Farmer "G" uses iron-ammonium citrate mixed with bran to keep the cows healthy. Four cows are kept on the average, and they have not been changed to other localities for three years. The cost of changing four cows for six weeks each was £4 4s.; the cost of 3 lb. of iron-ammonium citrate was 11s. 3d.

DISTRICT I.

This locality is very near excellent change-paddocks. Farmer "T" says that, while he finds the changing of stock easily first as a positive insurance against all loss, the top-dressing with sulphate of iron is valuable in assisting the stock (dairy cows) to be milked the full season, without shifting in mid-season; also that the iron-ammonium citrate has its use in treating cows that have either been bought in or missed being changed. He intends making most use of the sulphate of iron, and has had better farming results since commencing to use it.

DISTRICT J.

Farmer "P," who gives the citrate of ammonium and iron scales mixed with bran and linseed nuts to milking cows, weaners, and heifers has found this treatment efficient. One heaped teaspoonful to 2 quarts bran and 1 quart nuts is the dose used. In the case of a sick cow, if she is not in calf the dose is half-teaspoonful of the scales dissolved in 4 oz. of molasses and 1 quart of warm water. If the animal will eat this ration, three weeks shows a marked difference. This farmer's communication may be quoted fully as follows:—

We teach our calves to eat a ration (with the drug) before we change over from fresh to skim milk. After the skim-milk stage they get a pinch of iron once a week until weaning. Then before going to the dry herd they get a half-ration twice a day for a fortnight. From then on we keep a careful watch and bring them in once a month for a week or even less—say, three days—for a full ration. We have used the drug in the troughs for the dry stock, but prefer the ration method, although in the drinking-water the drug has an equally good effect. It has this disadvantage—some animals drink so much less (or *vice versa*) than others. We can only change on our own farm; without the iron the stock go back. We have had *no* failures.

That your theory is a correct one I am fully convinced. I could write reams of my own experiments, but time is short, and your patience might be likewise; but I consider my experiments finished. I would like to try a dressing of iron oxide on one paddock and keep the yearlings in it exclusively, but cannot afford it. For four years I set aside two check weaners, two check yearlings, and two check cows. In every case I would wait until the disease was well advanced, then treat one with the iron and let the other die. In every case I was able to save the one. Although I used to keep

only heifers that were rejects for my experiments, it proved beyond my resources. But I think one experiment will interest you. I have one cow—Octavia—who has never eaten a ration and has never shown any signs of sickness, keeping always in splendid condition, but she had never had a robust calf until the last. During the time she was carrying it, during her fifth month and again during her eighth, I gave her a week's course of iron, half-teaspoonful, as in the case of a sick cow if she is not in calf. That calf was robust and hardy, and at five months was bigger than the previous heifer, who was exactly twelve months older, by the same sire.

I am enclosing photos. They show the value of iron on the offspring when given to the mother. This year I am giving Octavia no iron whatever to see what sort of calf she produces. The heifer—Hermione—I had the greatest trouble to rear; the last calf—Isthar—never gave me one minute's worry. Another thing, Hermione was nineteen months of age before coming into season; Isthar came in during her fifth montn. That is another fact well worth noticing. When a female beast is sick or sickening she does not come into season, yet within four weeks of treatment we find them taking the bull.

Now for some adverse effects. When I started experimenting I overdid the dosage, and could not get my calves to hold. A local chemist put me right there; I borrowed his British Pharmacœpia, and between us we arrived at the reason; then I got at the minimum and worked up. Likewise, I get my bull fit before using; during the season I give him a half-dose of iron in his feed and have no trouble.

Of course, I use a lot of basic slag and super; I have also used White Island Product; also lime. But although I believe that with older pastures and top-dressing the sickness is greatly abated, I am still unable to be without the iron as supplied by your Department.

DISTRICT F.

Farmer "J" has cured several sick cows and calves with the iron scales. He finds that in the case of an adult beast it takes a total of about 1 lb. of the compound to effect a cure, this representing, at the approved dosage, a period of some two months. In the case of a young beast dosing for one week effects a cure. Dosing the animal with iron compares very favourably in his experience with the alternative method of changing stock to a non-sick pasture. He finds that while he grew turnips for the cattle very little sickness was experienced, but the last two seasons, having had no turnips, there has been quite a lot of trouble in his stock.

DISTRICT E.

Farmer "B" finds the method of dosing with iron-ammonium citrate very efficient with sick cows and calves, the usual length of treatment being fourteen days, given as a drench daily. He considers the method of giving the scales as a drench daily a cheaper method than "changing stock."

PRICE OF IRON-AMMONIUM CITRATE.

Owing to a reduction in the price of materials in England the Department has been able to reduce the charge for iron-ammonium citrate supplied to farmers in bush-sick areas from 3s. 3d. to 2s. 6d. per pound. Further, no additional charge will now be made for postage. These charges operated from the end of May.

PASSION-FRUIT AND ITS CULTURE.

W. H. RICE, Orchard Instructor, Auckland.

THE passion-vine is natural to most tropical countries, though most of the edible fruited varieties are native of Brazil. As found in their natural habitat the vines are most luxuriant and thrive best on the fringe of forests and in clearings, having a disposition to ramble over dead or decaying vegetation rather than mingle with heavy growth. The root-action is mainly restricted to heavy layers of decayed mould on the surface, rather than penetrating the heavy soil. In a state of nature it is very noticeable that the fruits are to be found on the extended tip growths only; the older parts of the vines form a dense mass of dry canes, the only wood of fruiting-value being the current season's extensions.

Of the fruiting varieties grown in New Zealand, *Passiflora edulis* and its varieties are the only ones so far proved of commercial value. These are the hard-skinned purple type. The ordinary *edulis*, given proper attention, produces fruits of good uniform size and well filled with pulp. The variation Mammoth, though nearly twice as large, cannot be depended upon to be so well filled and dries out more rapidly, becoming very wrinkled soon after picking. *P. Quitensis*, the pink-flowered, soft, cream-skinned, long oval-shaped fruit succeeds wherever the *edulis* grows. Though not grown to the same extent for commercial purposes, this variety is quite profitable and meets a fair demand.

Passion-fruit culture in New Zealand is restricted to the North Island and localities which are not subject to more than four degrees of frost. The vines come into bearing early, but are comparatively short-lived. The profitable bearing life of the plant may be considered to be from the second to the sixth year. *Passiflora edulis* is extensively imported into this country from Australia, and is yearly becoming more popular. The local-grown fruits are quite equal in quality, and the Australian importations mainly arrive after the local crop has been disposed of.

SOILS AND SITUATION.

Though not exacting as to soil-conditions, providing the drainage is good, passion-vines thrive best on light lands of good quality. Good drainage is decidedly the first essential, as the plants are very sensitive to stagnant water at the roots; but a good aspect, giving maximum sunshine with shelter from winds or the keen draught generated by shelter which does not reach to the ground, is also very necessary. The rows should run north and south or nearly, so as to give full sunshine both sides of the rows. The land should be well prepared by subsoiling, and worked to a fine state prior to planting, but if the land is rather heavy or deficient in humus a green crop, such as lupins or horse-beans, should be grown and turned in to improve the condition of the soil.

Owing to the comparative short life of passion-plants, they are very suitable subjects to grow as interplants with citrus-trees during orchard establishment. Land and situations suitable for citrus species may be regarded as suitable for passions.

PLANTING.

A suitable distance between rows will be 10 ft. to 12 ft.—according to the intended method of cultivation and implements to be used—with the plants 8 ft. to 10 ft. apart in the rows. Whatever method of training is decided upon, a substantial fence is necessary; adequate posts 5 ft. to 6 ft. out of the ground and 2 ft. to 2 ft. 6 in. in the ground, at 24 ft. intervals in the rows, should be put in prior to planting. If the overhead system of training is to be adopted, a 9 in. piece of 3 in. by 2 in. should be secured to each post, and No. 8 wire fixed to these on each side. Stakes are put in for each plant and secured to the top wires. The plants are trained up to the wires on a single stem by suppressing the laterals. Several leaders are then allowed to grow, these being trained along the wires. At intervals along these canes fruiting laterals are formed which hang down. When the fruit has been harvested the laterals should be cut back to within two buds of the base. These buds will supply next season's laterals, and so on year after year. The overhead system has an advantage in that the plants are readily pruned.

The overhead system of training is to be preferred for situations that are well sheltered, but in wind-swept or open areas the plants are considerably exposed by the elevation and readily damaged.

For the trellis system of training attach one No. 8 wire on top of the post, one in the middle, and one 9 in. above ground. Lace in these brushwood of a stability to last five years; or pig netting may be used. Train the leading growth fan-wise on to this trellis; from these shoots side fruiting laterals will be developed, which should be reduced to two buds after harvest, and so on season by season. This system, while not as tidy or allowing of such easy pruning as in the overhead system, gives greater fruiting surface and consequently more abundant crops. As the passion-vine bears the fruit on new wood only, if the pruning is not done annually tip extensions are made, which gves a luxuriant outer layer of vegetation and a mass of old canes and laterals on the inside. These tip extensions carry inferior fruit, and the old wood harbours disease and generally shortens the life of the plants.

PROPAGATION.

When the plants are to be raised *in situ*, seeds of selected fruits should be secured in season. After expressing the pulp it should be mixed with sand and dried, this being the most practical way to separate the seeds. On no account should they be washed, as seeds so treated invariably become infected with mildew. Seed-beds are prepared along the line of rows, and the seeds sown early in October as liberally to the clump as the quantity available will allow. As the plants grow they are thinned periodically, leaving the most robust each time, until by autumn they are single at the required intervals. Where the required care can be given, this method of establishment is to be preferred, as the passion-plant is a difficult subject to transplant without a high percentage of mortality.

TRANSPLANTS.

Plants removed from the open ground are rarely successful unless they have been wrenched at least twice during autumn and winter.

The best method is to sow the seeds in boxes during early October and transplant when large enough into other boxes, giving plenty of room to each plant—say, 4 in. by 4 in. The plants are then grown on and transplanted into the permanent quarters during spring or early summer, approximately a year after sowing. Care should be taken to avoid damage to roots or exposure at planting-time. For this reason pot-grown plants usually give greater satisfaction, though not as practical in a large way as box-grown.

CULTIVATION AND MANURING.

Continued soil-disturbance must be maintained and the surface soil never allowed to compact unduly, otherwise the rootlets are suppressed and the plants languish.

Fertilizers are best applied just prior to the commencement of growth in early spring. A mixture of two parts superphosphate, two parts sulphate of potash, and one part blood-and-bone should be applied at the rate of 2 lb. for young plants and 4 lb. to 6 lb. for fruiting plants, distributed and worked in over the whole area and not only immediately around the roots. An annual ploughing should suffice. This should be confined to the land between the rows up to within 3 ft. of the plants, and should be done during May, a month before pruning is carried out. If these two operations are performed any nearer together than one month the plants are apt to be checked substantially.

INSECT PESTS AND DISEASES.

Insect pests of the passion-fruit are fortunately few. Mealey bug attacks the vine and causes some damage by withdrawing nutriment from the plant. When this pest is present the infestation is usually found on the fruit-stalk, and in this position the bugs take great toll of the sap which should feed the fruit, and thus considerably retard development. There are no practical ready methods of controlling this pest, and in the event of the plants becoming heavily infected they should be pulled up and destroyed. It is noticeable, however, that plants kept in good health, as free as possible from old worn-out wood and openly pruned, are least infected. The passion-vine hopper is usually associated with the plant, but damage from this insect is not severe, which is fortunate, as there is no reliable method of control.

Old foliage in the process of decay on the ground develops a mildew. This mildew often attacks the crown of the plant or the stem just above the ground, resulting in the death of the plant. Isolated plants only are lost in this way, so that the trouble is rarely noticed until too late. A surface dressing of sulphur, at the rate of about 3 cwt. per acre, along the base of the rows every midwinter is very beneficial.

During the last few seasons plants in some localities in North Auckland have been infected with a leaf-spot (*Septoria longispora*) which causes premature dropping of foliage and consequent mal-nutrition of fruit. While experiments with this disease have not advanced enough to allow a complete preventive or remedy to be prescribed, bordeaux mixture, 4–4–40, applied just before flowering and again prior to the fruit colouring, is giving good results. The

disease also attacks the canes and causes a stricture which checks the flow of sap. This form of attack may also cause considerable mortality among young plants It is, therefore, advisable to plant more in the rows than will be permanently required, and reduce the number as establishment becomes assured.

MANURING OF EARLY POTATOES.

EXPERIMENTS IN AUCKLAND PROVINCE, SEASON 1927.

T. H. PATTERSON, H.D.A., late Instructor in Agriculture, Auckland, and J. W. WOODCOCK, N.D.A., Instructor in Agriculture, Taumarunui.

AN initial report on three experiments conducted in Auckland Province during the season of 1926 was published in the *Journal* for March, 1927. The results obtained suggested further investigations, and questions which arose were: (1) How far could super profitably replace slower-acting phosphates such as bonedust and rock phosphate? (2) Could the total amount of manure used per acre be economically reduced? (3) What effect would the addition of soluble nitrogen have on the yield of the crop?

It had been found that bonedust could be replaced to a certain extent by superphosphate if the nitrogen was substituted by the addition of a soluble nitrogenous fertilizer. This, however, was the result as indicated by one season's experiments, and in order to further test this conclusion the two experiments commenced in 1926 at Pukekohe and Taupiri were repeated with certain modifications during the 1927 season. The fertilizer mixtures used were as follows:—

	Per Acre.
(1) Superphosphate	15 cwt.
Sulphate of ammonia ..	3½ cwt.
Sulphate of potash	2 cwt.

	Per Acre.		Per Acre.
(2) Bonedust	7½ cwt.	(3) Super	7½ cwt.
Superphosphate ..	7½ cwt.	Ephos phosphate ..	7½ cwt.
Sulphate of ammonia ..	1⅜ cwt.	Sulphate of ammonia ..	3⅛ cwt.
Sulphate of potash ..	2 cwt.	Sulphate of potash ..	2 cwt.

Instead of the pure bonedust used during the previous year, it was thought advisable to introduce a mixture (No. 1) in which the whole phosphate content was made up of superphosphate, but the amounts of potash and nitrogen were kept constant. In No. 2 mixture the nitrogen was present partly in organic form, and this difference in the form of nitrogen may have had some effect on the result.

The relative merits of organic and inorganic nitrogen on the potato crop were investigated during the year at Avondale, and the results of this experiment (which will be discussed later) have a direct bearing upon those under review.

Trial on Farm of E. J. Campbell, Pukekohe.

The field selected for this experiment adjoined that used last season, and, although the soil was very similar, instead of being ploughed out from permanent pasture it had been in temporary grass for two years,

following the rotation of two years cropping and two years grass adopted by the more progressive growers in the Pukekohe district. Consequently the supply of organic matter was not so good as formerly, although a fair turf was ploughed in. Sowing was done on 14th and 15th June, and, as in all the experiments under review, cut sets of the Gamekeeper variety were used for seed, being planted by hand and ploughed in with the manure.

There was no difference to be seen in the tops during growth, but owing to the excessive rains during July and August the yield suffered considerably, both from the wet conditions and through attacks of Irish blight, which practically defoliated the plants some time before harvesting.

When the crop was dug on 2nd and 3rd November the ground was very hard, due to lack of cultivation and the hot sun baking the ground surface after heavy rain. Strange to say there were considerable amounts of undissolved fertilizer still to be found under the plants, even after the ground had been saturated with the heaviest winter rainfall for a number of years. The yield was unusually light, as were most crops in the district. The middle row of each plot was dug by hand, and the tubers graded into first grade, second grade, and small. Potatoes were quoted at £17 10s. per ton for first grade and £7 10s. for second grade at that time, but in the subsequent tables no value has been placed on the small, unsaleable potatoes. Results for the experiment under review are tabulated below.

Table 1.—Results at Pukekohe (E. J. Campbell).

Type of Phosphate.	Yield per Acre.				Cost of Manures per Acre.	Value of Increase per Acre.	Profit per Acre.
	First Grade.	Second Grade.	Total.	Small.			
	Tons cwt. lb.	Tons cwt. lb.	Tons cwt. lb.	Cwt. lb.	£ s. d.	£ s. d.	£ s. d.
A. 15 cwt. super	2 5 70	0 19 22	3 4 92	12 0	7 18 8		
B. 15 cwt. super plus bonedust	2 1 49	0 18 35	2 19 84	11 51	9 0 4		
Difference in favour of A	0 4 21 S.	0 0 99 N.S.	0 5 8 S.	..	1 1 8	3 7 9	4 9 5
A. 15 cwt. super plus Ephos	2 4 61	0 18 83	3 3 32	12 71	9 3 0		
B. 15 cwt. super plus bonedust	2 1 49	0 18 35	2 19 84	10 83	9 0 4		
In favour of A	0 3 12 N.S.	0 0 48 N.S.	0 3 60 N.S.	..	..	2 8 6	2 5 10
A. 15 cwt. super	2 5 99	0 18 49	3 4 36	12 0	7 18 8		
B. 15 cwt. super plus Ephos	2 4 61	0 18 83	3 3 32	12 71	9 3 0		
In favour of A	0 1 38 N.S.	0 0 34 N.S.	0 1 4 N.S.	..	..	0 18 9	2 3 1

S.=Significant difference; N.S.=Non-significant difference. (In the Statistical treatment of experimental results a difference is regarded as "Significant" where the chances are greater than 30 to 1 in its favour.)

Comments on Table 1.

The 15 cwt. superphosphate mixture has given an increase of 5 cwt. of saleable potatoes over the yield of the super plus bonedust plots. Allowing £15 as the net value per ton for first grade, after deducting the cost of digging and carting (£2 per ton) and adding the difference in the cost of manures, the profit derived by using the former has amounted to £4 9s. 5d. per acre. The remaining comparisons are not significant when treated statistically, and cannot be accepted with certainty, although super plus Ephos, as in the previous year, shows a slight superiority over super plus bonedust. Ephos phosphate, however, has increased in price since last year, and with a slight fall in the price of bonedust the former mixture has become more expensive than the super plus bonedust. The results obtained by eliminating bonedust altogether and by using wholly superphosphate, yet keeping up the nitrogen supply by the use of sulphate of ammonia, have been highly satisfactory even in a season when the rainfall was well above the average.

Farm of S. V. Bilkey, Taupiri.

The area selected for the experiment at Taupiri had been in pasture for a number of years, but the grass was not of good quality. The soil was slightly heavier than that on the field used for last season's experiment, and could not be got into suitable condition for planting until 6th and 7th August. On account of an error in mixing the manures it was found that the plots had received 4 cwt. of sulphate of potash per acre instead of the intended 2 cwt. On 8th November it was noticed that the 15 cwt. superphosphate plots appeared to be

Table 2.—Results at Taupiri (S. V. Bilkey).

Treatment.	Yield per Acre.		Cost of Manures per Acre.	Value of Increase.	Profit.
	Saleable.	Small.			
	Tons cwt. lb.	Cwt. lb.	£ s. d.	£ s. d.	£ s. d.
A. 15 cwt. super	9 1 16	13 72	7 12 6		
B. 7½ cwt. super plus 7½ cwt. bonedust	8 13 71	14 73	8 16 6		
Difference in favour of A	0 7 57 N.S.	..	..	3 7 8	4 11 8
A. 15 cwt. super ..	8 14 47	13 72	7 12 6		
B. 7½ cwt. super plus 7½ cwt. Ephos	8 2 74	13 15	8 7 6		
In favour of A ..	0 11 85 S.	..	..	5 6 0	6 1 0
A. 7½ cwt. super plus 7½ cwt. bonedust	8 13 71	14 73	8 16 6		
B. 7½ cwt. super plus 7½ cwt. Ephos	8 2 74	13 15	8 7 6		
In favour of A ..	0 10 109 S.	..	..	4 18 7	4 9 7

much more vigorous than the remainder, but this difference was not apparent when the crop was dug. The plots were harvested on 13th and 14th December, and the tubers were divided into "saleable" and "small." Results are presented in Table 2.

Comments on Table 2.

Super *versus* super plus bonedust: Although the 15 cwt. super mixture gives a fairly substantial increase over super plus bonedust, this increase is not significant when treated statistically.

Super *versus* super plus Ephos: When these two are compared there is a significant increase in favour of super, and the profit obtained by using the former amounts to £6 1s. per acre.

Super plus bonedust *versus* super plus Ephos: An increase of nearly 11 cwt. in favour of super plus bonedust is significant, showing a profit of £4 9s. 7d. per acre, although in this case the Ephos mixture is slightly cheaper. Although this comparison in 1926 gave a non-significant result, there was an increase in favour of super plus Ephos, but this was reversed during last season.

Residual Effect of Bonedust.

In the account of the results obtained in 1926 the question of the residual effects or "lasting" qualities of bonedust was discussed, and this was stated to be one of the reasons for the popularity of bonedust among potato-growers.

In order to test the residual effects of the manures used in the 1926 season, the areas at Pukekohe and Taupiri were sown with a main crop during November and December, 1926, respectively. The rows were arranged as far as possible to coincide with the rows of the previous crop, and a standard mixture of 7 cwt. manure was applied throughout. The crops were dug at Pukekohe on 23rd March, and at Taupiri on 1st April, but the differences obtained at both centres were not significant when treated statistically, and such differences cannot be attributed to any particular treatment. The results obtained at Pukekohe are given in the following table:—

Table 3.—Results of Second Crop at Pukekohe, 1926–27 (Farm of E. J. Campbell).

Treatment: Standard Manure plus—	Yield of Saleable Potatoes per Acre.	Difference in Favour of A.	—
	Tons cwt. lb.	Cwt. lb.	
A. Residues of 15 cwt. bonedust ..	6 9 39		
B. Residues of 15 cwt. super plus bonedust	6 6 38		
		3 1	N.S.
A. Residues of 15 cwt. bonedust ..	6 12 16		
B. Residues of 15 cwt. super plus Ephos	6 6 78		
		5 50	N.S.
A. Residues of 15 cwt. super plus Ephos	6 6 78		
B. Residues of 15 cwt. super plus bonedust	6 5 83		
		107	N.S.

A further attempt is being made at the two centres to test the residual effect of the manures used in the 1927 season.

Effects of Nitrogen: Trial on Farm of J. Capes, Avondale.

In the experiments at Pukekohe and Taupiri conducted over two years no account has been taken of the difference between organic and inorganic nitrogen, yet it may be that the difference in form of this element has had something to do with the superiority of the more soluble phosphates. Furthermore, the economical amount of nitrogen to apply to the potato crop has not been investigated, and while a small amount of available nitrogen is generally added to the potato manurial mixture there is no evidence to show that an increase in the amount used would not be beneficial, although it is the general tendency at Avondale to use more nitrogen in the mixture, chiefly as blood and bone, in lieu of bonedust.

An experiment was laid down at Avondale in 1927 to try the effects of increasing the nitrogen in the mixture, using it both in the form of dried blood and as sulphate of ammonia. To a basic mixture consisting of 7 cwt. superphosphate, 7 cwt. bonedust, and 2 cwt. sulphate of potash, per acre, were added: No. 1—2 cwt. sulphate of ammonia; No. 2—3 cwt. dried blood; No. 3—4 cwt. sulphate of ammonia.

The field used for the experiment had been previously cropped for two years with potatoes, and the soil was of the clay loam typical of the Avondale flats. Sowing was done on 2nd and 3rd August, and the seed, which was autumn-grown Gamekeeper, had been stored for some time in shallow trays. The tubers were planted by hand and carefully picked over, so that any which showed no signs of sprouting were discarded. All through the growing-period the tops of the rows which had received the heavier dressing of sulphate of ammonia could be easily distinguished, being more vigorous and greener than the rest.

The crop was dug on 23rd and 24th November, and the tubers were separated into "first grade," "second grade," and "unsaleable." This crop caught a rise in prices, and first grade were then quoted at 2¼d. per pound and second grade at £11 per ton. Results are summarized in Table 4.

Comments on Table 4.

Sulphate of ammonia, 2 cwt., *versus* blood, 3 cwt.: Although the ammonia yielded 11 cwt. of first grade more than the blood plots, there was a greater proportion of second-grade potatoes in the latter, which reduced the difference in the total to 9 cwt. in favour of the 2 cwt. sulphate of ammonia. This represents a profit of £9 4s. 5d. per acre, after deducting charges for digging, commissions, &c., and the difference in the cost of the manures.

Sulphate of ammonia, 4 cwt., *versus* blood, 3 cwt.: The increase in favour of the larger amount of sulphate of ammonia is considerable, amounting to over 23 cwt., and this represents a profit of £18 14s. 3d. It is clear that at least a portion of the nitrogen supply should be in the form of sulphate of ammonia or other available form.

Sulphate of ammonia, 4 cwt., *versus* 2 cwt.: There is a total increase of nearly 16 cwt. in favour of the larger amount, which shows a profit of £11 16s. 9d. per acre. The good result obtained by increasing the amount of soluble nitrogen is therefore highly satisfactory, and it remains a very interesting question as to how much further the nitrogen can be increased and yet give profitable results.

Table 4.—Results at Avondale (J. Capes).

Comparison A *versus* B: Standard Manure plus—	Yield of Saleable Potatoes per Acre.			Unsaleable.	Cost of Manures.	Value of Increase.	Profit.
	1st Grade.	2nd Grade.	Total.				
	Tons cwt. lb.	Tons cwt. lb.	Tons cwt. lb.	Cwt. lb.	£ s. d.	£ s. d.	£ s. d.
A. 2 cwt. sulphate of ammonia	8 16 58	1 15 14	10 11 72	15 18	9 12 6		
B. 3 cwt. dried blood	8 5 56	1 16 91	10 2 35	10 12	10 6 0		
Difference in favour of A	0 11 2 S.	.. N.S.	0 9 37 S.	..	..	8 10 11	9 4 5
A. 4 cwt. sulphate of ammonia	9 12 18	1 15 14	11 7 32	7 65	11 8 6		
B. 3 cwt. blood	8 8 40	1 15 56	10 3 96	15 18	10 6 0		
In favour of A	1 3 90 S.	.. N.S.	1 3 48 S.	..	..	19 16 9	18 14 3
A. 4 cwt. sulphate of ammonia	9 12 18	1 15 14	11 7 32	7 65	11 8 6		
B. 2 cwt. sulphate of amomnia	8 15 60	1 15 101	10 11 49	10 12	9 12 6		
In favour of A	0 16 70 S.	.. N.S.	0 15 95 S.	..	..	13 12 9	11 16 9

Importance of Seed-selection.

Although the first few weeks were very unfavourable to growth, the yields from the plots at this centre were most encouraging. This could not be attributed to manuring alone, nor to any great superiority of soil, but it may have been due in large degree to the sprouting of the seed in trays. Any tuber showing weakness of the shoot or any disease was discarded, since every tuber was examined when planted. This laborious method of planting will be quite justified, especially on land valued at £200 per acre, which should be treated intensively in every way. It is to be deplored that more care is not exercised in the storing and selection of seed-tubers than is usually the case in the early-potato districts.

Quantity of Manure : Trial on Farm of C. Austin, St. Heliers Bay.

The question often arises as to whether the amount of fertilizer applied to the potato crop, which is often round about 1 ton per acre, could not be reduced. It has been previously mentioned that both at Pukekohe and Taupiri, where up to 1 ton per acre of manures was used, that even after the heavy rains during the winter of 1927 there appeared to be large quantities of manure left in the ground after digging. It might be possible therefore to cut down the amount of manure applied to the crop without seriously affecting the yield, and thereby reduce the cost of production, since the manure bill is often from one-fourth to one-fifth of the cost of growing the crop.

An experiment conducted at St. Heliers Bay in 1927 was designed to try the effects of reducing the amount of a manurial mixture. The mixture used was made up of five parts (by weight) of superphosphate, five of bonedust, and two of sulphate of potash. Of this mixture 7 cwt., 10 cwt., and 15 cwt. per acre were used on the respective plots.

The area on which the trial was conducted was composed of dark volcanic loam, and it had been cropped with potatoes for the two preceding years. The crop was planted on 19th and 20th July, and harvested on 21st and 22nd November. During the growing-period no marked difference was to be seen between the plots. At the time of digging, first-grade potatoes were selling at 2¼d. and second-grade at 1d. per pound. Results are given in the following table:—

Table 5.—Results at St. Heliers Bay (C. Austin).

Amount of Mixture used.	Yield of Saleable Potatoes per Acre.			Unsaleable.	Cost of Manures.	Value of Increase.	Profit.
	Total.	1st Grade.	2nd Grade.				
	Tons cwt. lb.	Tons cwt. lb.	Tons cwt. lb.	Cwt. lb.	£ s. d.	£ s. d.	£ s. d.
A. 10 cwt. ..	6 3 56	5 3 50	1 0 6	11 70	4 18 4		
B. 7 cwt. ..	5 13 43	4 14 96	0 18 59	11 41	3 8 10		
Difference in favour of A	0 10 13 S.	0 8 66 S.	0 1 59 N.S.	..	..	7 17 2	6 7 8
A. 15 cwt. ..	6 7 82	5 7 92	0 19 102	11 98	7 7 6		
B. 10 cwt. ..	6 3 56	5 3 50	1 0 6	11 70	4 18 4		
In favour of A	0 4 26 N.S.	0 4 42 S.	.. N.S.	..	..	3 12 4	1 3 2
A. 15 cwt. ..	6 7 82	5 7 92	0 19 102	11 98	7 7 6		
B. 7 cwt. ..	5 17 16	4 15 89	1 1 39	11 41	3 8 10		
In favour of A	0 10 66 S.	0 12 3 S.	.. N.S.	..	..	9 19 0	5 11 4

Comments on Table 5.

10 cwt. of mixture *versus* 7 cwt.: The larger application of manure has resulted in an increase of over 10 cwt. of saleable potatoes, which represents a profit of £6 7s. 8d. after deducting digging costs, auctioneer's commission, and the difference in cost of manures.

15 cwt. *versus* 10 cwt.: While there is an increase of over 4 cwt. of first-grade potatoes in favour of the larger dressing of manure, the difference in total yield is not significant, but there is sufficient evidence to show that at 15 cwt. the limit of manuring has apparently not been reached. The application of 15 cwt. shows a profit of £1 2s. 3d. over the 10 cwt. dressing after deducting the difference in cost of the extra manure.

15 cwt. *versus* 7 cwt.: The larger amount gives a difference of over 12 cwt. of first-grade tubers, which is highly significant, although the 7 cwt. dressing gives more second grade, which brings down the difference in total to 10½ cwt. The profit derived by using the heavier dressing amounts to £5 11s. 4d. per acre. It appears, therefore, that

the amount of manure cannot be reduced to any advantage below 15 cwt. under conditions similar to those pertaining in the 1927 season.

Conclusions.

As in the previous season, the results obtained in 1927 go to show that the bonedust can be reduced in the mixture, and can be replaced partly and in some cases wholly by cheaper phosphates—particularly super—provided that the nitrogen supply is kept up.

The use of soluble nitrogen, in the form of sulphate of ammonia, gives better results than dried blood, and an increase in the amount of the former has been responsible for an increase in yield. This matter needs further investigation.

The large amounts of manure at present applied to the potato crop cannot be reduced to any great extent without decreasing the yield.

It is clear that results secured by one or two years' trials must be accepted only tentatively, as results vary from season to season. Other experiments in New Zealand and beyond also show the same to be true. It is desirable, if not actually necessary, to carry on the trials for, say, five years, before finality can be hoped to be reached for some innovation working out better than long-established farm practice. This is the time-period which is being aimed at in this series of trials.

We again tender the growers—Messrs. E. J. Campbell, S. V. Bilkey, J. Capes, and C. Austin—our thanks for their co-operation. We also acknowledge the help rendered by colleagues of the Fields Division.

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A NEW DRINKING-WATER SYSTEM FOR POULTRY-HOUSES.

L. W. C. COCKER, Poultry Instructor, Wellington.

IN designing and laying out a system for supplying drinking-water for poultry the first care should be to see that it will meet all the various requirements for watering the stock in a hygienic manner.

Undoubtedly the most important requirement is that the water shall at all times be as pure and fresh as possible, for it can be well understood that impure drinking-water not only leads to impaired health in the stock, but also has an undesirable effect on the egg-product. The logical conclusion, therefore, is to avoid any system wherein it is possible for the water to become contaminated with litter, droppings, &c. In addition, the system should be such as to eliminate the spilling of water by the birds, and thereby keep the litter as dry as possible, for damp floors and litter are not favourable to the health of poultry. Further, such conditions are favourable to disease and the spread of intestinal parasitic life. The question of how to avoid intestinal parasitic infection of poultry is of great importance. Mortality from this cause is more extensive than commonly realized, while the economic loss through unthrifty flocks due to the ravages of these parasites is also considerable.

Another important matter to be considered is economy of labour. Consideration given to this point is time well spent, for it is well to remember that a poultry plant is not erected and equipped for a few weeks or months, but with a view to providing a partial or whole livelihood for the owner. In the case of the side-line poultry-keeper a great deal of the care of the flock usually falls on the womenfolk of the home, and if for no other reason the work of watering the flock should be made as light as can be. In the system here described the writer has given this aspect of the matter some thought, and endeavoured to meet the needs of the commercial poultryman as well as the side-line poultry-keeper in designing an efficient and practical system within the reach of both, and inexpensive as regards its initial cost or upkeep.

Firstly, as regards a pure water-supply free from contamination, this has been provided for as far as possible in that the tank is placed in such a position that the fowls have to fly up to a lattice platform before being able to secure water. Secondly, each pen has its own supply and overflow of waste, for the reason that should an epidemic of roup, chicken-pox, or other poultry ailment break out it is much easier to overcome the trouble than where the water runs from pen to pen, supplying each house with the overflow of the one before. Thirdly, the keeping-quality of eggs produced and properly gathered on plants where the water-supply is as it should be is very much better than where the fowls are allowed to drink water of a questionable nature.

The accompanying photographs were taken at the Wallaceville Poultry Station, where the system is working quite satisfactorily. The water is brought into the plant by a $\frac{3}{4}$ in. main, and runs through the houses on the under side of the ceiling rafters. At the junction of each

FIG. 1. ONE OF THE DRINKING-TANKS, SHOWING DRIP METHOD.

This tank is serving two compartments in the house. Platform for the birds is seen in front.

FIG. 2. THE SAME TANK SEEN FROM OTHER SIDE OF PARTITION.

In this view the waste-pipe is seen below tank. Note also triangular piece of iron across left corner of tank to protect waste-plug.

[*Photos by H. Drake*

partition wall there is a ½ in. reducing T joint, and from this point the water is led to the tank by a ½ in. pipe, on the end of which is screwed a small gas-tap similar to those used for gas-rings, &c. This tap when turned on can be adjusted to supply all requirements from a drip to a small jet of water—quite ample for the desired purpose. The platform for the fowls to drink from is fixed 2 ft. from the floor, and is 10 in. below the top of the water-tank. The lattice platform should not be too wide—from wall to outer edge, 13 in. by 2 ft. long, will be quite sufficient — so that the birds cannot move away from the tank and spill drops of water, making the floor of the house wet and damp. Further, there is not room enough to induce birds to congregate, with a corresponding trouble from resulting droppings. The tank itself may be fitted to protrude through the partition, thus supplying two compartments instead of one. In the event of necessity one side can easily be shut off by simply laying a 5 in. piece of tin or board over the top of the tank. The double tank is 15 in. by 10 in. by 5 in. deep.

FIG. 3. SINGLE TANK, SHOWING WASTE OUTLET AND PLUG.

For the purpose of the illustration the overflow-plug has been moved and reversed to show escape holes in bottom.

[*Photo by H. Drake.*

In the bottom of the tank, toward the rear wall end, just sufficiently far away from the centre-line to allow of the overflow waste-pipe running along the partition wall on its course to the rear wall of the house, is soldered a 1¾ in. waste-plug fixing. On the plug itself is soldered a round piece of 1½ in. galvanized piping, which when inserted in the plug fixing should be ½ in. below the level of the top of the water-tank. Three ¼ in. holes are bored in the plug, which allows the overflow of water to escape. On the bottom of the tank a small sleeve of galvanized pipe is soldered, to allow of a slip-joint into the larger waste-pipe leading out of the house. A rolled lip is provided on the front of the tank, with a tilt upwards to divert back into the receptacle any drops which may fall from the wattles and beak of a bird. A small three-cornered piece of sheet iron is soldered across the corner of the tank immediately above the waste-plug, so as to prevent the birds interfering with the plug, in which case the tank would remain empty.

If an occasional inspection and ordinary attention are given to the taps to prevent any clogging, by allowing the taps to free themselves by turning full on, this system will be found useful, sanitary, and very labour-saving.

CONTROL OF BROWN-ROT IN STONE-FRUITS.

EXPERIMENT WITH PEACH-TREES AT HENDERSON, 1927–28 SEASON.

Horticulture Division.

THE experiment on the control of brown-rot fungus (*Schlerotinia cinerea*) which has been carried out over a period of several years in co-operation with Dr. R. H. Makgill, in his orchard at Henderson, near Auckland, was continued throughout the past season. The treatment on this occasion was a repetition of the programme carried out during the previous year, and published in the *Journal* for October, 1927.

The results as regards fruit-rot were better in all sections, probably owing to the drier summer weather experienced, although this improvement was not noticeable in stone-fruit orchards in the same locality where little or nothing was done to control this fungus. While the results showed a general all-round improvement, the relative merits of dry mix sulphur, Sulpho, and atomic sulphur remained the same. The amount of fruit-rot infection was ½, 1 to 2, and 5 to 7 per cent. of the crop respectively, while on the check trees (which received only the first three applications of spray) the respective losses were 3, 5, and 9 per cent. Trees receiving little or no attention in other orchards in the locality lost 40 to 60 per cent. of fruit.

All through the season a decidedly better general condition of the trees receiving dry-mix sprays was evident when compared with blocks of trees receiving other treatment. This was so marked that the owner of the orchard has decided that the best results over many seasons of experimentation were secured by this spray, and it is worthy of adoption as a routine treatment.

It is important to remember that for the last nine years strict orchard sanitation has been observed in this orchard. No infected fruit has been allowed to remain on the trees or come in contact with other fruit in the containers used for harvesting, and all infected fruit has been promptly destroyed. During pruning all diseased or doubtful wood was removed and cleared away, not even small twigs were allowed to remain on the land or be turned under.

The recipe for the dry mix spray used is as follows:—

Take 16 lb. fine powdered sulphur, 5 lb. fresh rock lime, and ½ lb. casein. Wet the casein and dissolve it with ¼ pint of caustic-soda solution. Stir well, and bring the mixture to the consistency of milk by making it up to 1 gallon with water (caustic-soda solution is made by dissolving 1 lb. caustic soda in 1 gallon of water). Sift the sulphur and make it into a paste with water; add the gallon of dissolved casein and as much more water as is necessary to bring it to the consistency of cream. Slake the lime carefully and dilute the milk to 10 gallons with water. Strain it into the spray-tank, start the agitator working, add the "creamed" sulphur, and make the spray up to 100 gallons with water.

SOME POINTS IN SEED-TESTING.

N. R. Foy, Seed Analyst, Biological Laboratory, Wellington.

THE GERMINATION TEST IN RELATION TO VALUE.

MANY merchants and farmers are inclined to regard the germination test as the most important indicator of value in seed, and in some respects this is true, for no matter how pure a line of seed may be if there is no growth the value is nil; moreover, when one considers that most good-quality seed is highly machined this view is not unreasonable. However, both purity and germination must be considered in accurately assessing value.

Germination is the capacity of the seed to grow to produce normal plants. High germination means high seed-vitality, and high vitality means success in the competition which must arise with other plants—either sown or present in the soil—and ability to withstand adverse conditions. Seed-vitality is measured by what is known as the germination-speed—that is, the speed in which growth commences after the conditions necessary to germination have been applied. To illustrate this point, two lines of turnip-seed may both be represented with a total final growth of 92 per cent. in ten days—one with a four-day growth of 90 per cent., and the other with a four-day growth of 65 per cent. The first line is one of high vitality, and, should adverse conditions such as drought or weed competition arise after sowing, will stand by far the better chance of returning a successful crop than the low-vitality line, a great number of the plants of which would succumb to the same conditions. Purchasers, then, should demand seed not only of a high growth but of a high vitality, a point which is frequently ignored by farmer and merchant alike.

The germination percentage of seed is dependent upon several factors, and varies among different species. A percentage which is poor for one species may be good for another, and farmers should make themselves acquainted with the approximate standards for the different varieties of grass and clover which they handle. The main factors are as follows:—

(1) The degree to which the line has been dressed: This refers more particularly to cocksfoot, average samples of which contain 15 to 25 per cent. of empty seeds incapable of growth, and whose germination percentage, therefore, rarely exceeds 80 per cent.—a figure which is low for crested dogstail or clovers, where there are no empty seeds present.

(2) The age of the seed: Some seeds retain vitality over a considerable period of years (white clover especially), but in the majority of seeds vitality commences to decline about twelve months after harvesting, and after two years the germination percentage is rapidly falling, or in some seeds will be almost nil. The ability to retain vitality is dependent to a large extent upon the degree of maturity of the seed when harvested. The more complete the maturity of the seed the longer will the seeds retain their vitality. The germination speed, besides indicating vitality, is thus also an indicator of age and maturity.

Farmers, however, may be well advised, as a general rule, to procure seed of the current season's harvest, and usually this is obtainable only from the higher-class seed-merchants. It is a fact that many small vendors operate very largely with the left-overs of the larger seed-houses. These latter make it their business to restock every season, and often guarantee germination, for the reason that behind their sales stands a valued reputation.

PURITY AND VALUE.

The average seed-sample contains impurities—commercial seeds, weed-seeds, and inert matter. The commercial seeds are those which are known variously as useful seeds or crop seeds. In small percentages they are without significance, as, for example, 1 or 2 per cent. of rye-grass in cocksfoot, or alsike or suckling clover in white clover. When, however, the percentage is above the normal, one of 2 per cent. or less, the value of a line of seed may be considerably reduced. Thus, cocksfoot at 1s. 3d. per pound containing 10 per cent. of rye-grass at 5d. per pound is not good value; nor is white clover at 1s. 6d. containing 5 to 15 per cent. of suckling clover worth only 6d. per pound. Samples of white clover, prices at 1d. and 2d. below the ruling rate, analyse at the Official Seed-testing Station, have shown up to 40 and 50 per cent. of suckling clover.

These may be cases either of ignorance or wilful deception on the part of the seller, but it is well known that such seed is sold in quantity. The weed-seed content of most highly machined seed is small, and such seed need not occasion much anxiety. There are, however, a few exceptions—for example, Californian thistle frequently occurs in high-grade crested dogstail, clover dodder in white clover, and ox-eye daisy in Danish cocksfoot. Low-grade samples of dogstail and white clover are almost certain to contain the impurities mentioned.

SYSTEM IN GERMINATION TEST.

The first operation in the germination test, as carried out at the Official Station, consists of the counting and separating from the sample of two or more lots of 100 seeds of the species named on the sample packet. Thus, if a sample is named as white clover, only pure white clover is taken, no matter how much alsike, suckling clover, or weed-seed may be present. There seems to be a fairly common impression that the lots of 100 seeds may contain anything that the sample contains; but this is not so, the counting of pure seed being strictly adhered to. In the case of grass and clover seed mixtures, the Station is frequently asked to put these to germinate *as* mixtures. For a number of reasons, however, this is not practicable, one of the main considerations being that in such mixtures the component seeds are present in different proportions, and are of different sizes and weights; so that several lots of 100 seeds counted in as they come would be extremely unlikely to represent the true proportion of the bulk. Mixtures, therefore, have to be separated into their component parts, and each constituent is tested separately, just as though it were an individual sample.

(N.B.—The foregoing notes are extracts from a recent radio broadcast lecturette.)

EDWIN HALL: PIONEER IN RURAL PROGRESS.

By the death of Mr. Edwin Hall, of Onehunga, Auckland, on 6th June, rural New Zealand lost one who had given it some forty years of devoted service. He came of English farming stock, and was himself engaged in active farming during earlier years in this country. His main activities, however, were in connection with the Board of Agriculture (from its institution), the Auckland Agricultural and Pastoral Association, the late Council of Agriculture, and the Farmers' Union. Together with the promotion of scientific agriculture, his wide range included such special interests as co-operative organization, agricultural education, and the improvement of rural facilities through telephones and better roads, his knowledge of these subjects being strengthened by investigations abroad. Among Mr. Hall's other public service was membership of the Prisons Board, where his bent found an outlet in the support of prison-farm activities which have proved so successful in this country. His constructive, well-stocked mind, and remarkable prevision at various points of advance in scientific agriculture (notably as regards the mineral content of pastures and top-dressing in relation to animal nutrition) are recalled by those closely associated with him in his life-work. On the personal side a kindly, unassuming disposition endeared him to many friends. A quiet but effective force for progress, the memory of Edwin Hall will be preserved in the annals of New Zealand agriculture.

Wool Research.—Reporting to a recent meeting of the Council of Scientific and Industrial Research, the Acting-Chairman stated: "A considerable amount of wool-fibre measurement, fleece-examination, and other work has been done in connection with determining the alleged faulty qualities of New Zealand wool. The investigations to date have yielded valuable information, but have also revealed the fact that the problem is one of very great complexity. Useful contracts have been made with similar researches in Australia, Great Britain, and Germany, but up to the present no clear-cut line of method of investigation into the problem of wool-improvement has been revealed. It will apparently be necessary to measure, record, and examine a large number of known fleeces in the hope that such characters will emerge as will suggest definite lines of investigations. . . . Suggestions have been received from the Woollen Research Association in Great Britain as to linking up the work with Australia, South Africa, and Great Britain in an Empire scheme."

SEASONAL NOTES.

THE FARM.

PREPARATION OF LAND FOR SPRING-SOWN CEREALS.

SPRING oats and wheat are usually sown in August and early September, and barley in September and very early October, so as to avoid the crop being flooded in the early spring. The nature of the preparatory cultivation for these crops will depend on the class of land and the position they take in a given paddock rotation.

Land after swedes or soft turnips is usually not clear till the end of July or middle of August, so that the seed-bed for spring cereals after roots may be quickly prepared. Cultivation work should be pushed ahead during all good weather, and the oat crop is usually drilled before a start is made on the preparation of the seed-bed for the barley crop. On light land the roller can be used with advantage in consolidating the seed-bed, but on heavy land its use should be avoided, as it causes the soil to settle down and cake. Spring-sown cereals benefit from a rolling after drilling, but unless the land is light the rolling should be delayed till late September or early October, when the land is drier. Rolling hardens the surface, breaks the clods, and lessens the amount of dust at harvest-time. In places of low rainfall cereal crops should not be rolled until the crop is 8 in. to 10 in. high, so that moisture will not be lost by evaporation from the bare, rolled surface.

Oats do better after grass than any other cereal. On light land the ground should be ploughed in July, rolled on the furrow, disked to a fine seed-bed, and harrowed and rolled before drilling. On heavy land the ploughing can often be best done with the digger plough with a skim coulter and knives attached to the tail-plates, which leaves the land in a fit condition for disking.

Spring cereals often follow a winter fallow, and are usually taken in this place when the land was prepared for autumn and winter cereals and the weather prevented sowing at the proper time. Barley often does best when taken in this position in the rotation. If the land has settled down badly in the winter, it should be ploughed and worked down again before the crop is drilled.

Cereals sown in the spring require a heavier seeding than when sown in the autumn, because less tillering takes place than is the case with autumn-sown crops. Also with cereals for threshing, a light seeding in the spring will give rise to a number of late tillers, and consequently a high proportion of shrivelled grain. The average seeding for spring cereals will be about 2½ bushels to the acre, but the amount will vary from 2 to 3 bushels, depending on the cereal and the local conditions of soil and climate.

PASTURE-MANAGEMENT.

All dairying pastures will benefit from thorough chain and tripod harrowing during the winter. Especially so is this the case with pastures on which winter supplementary feeding has been carried out. The organic matter of the spread droppings has a wonderfully

stimulating effect on both clovers and grasses, and frequent chain harrowing is essential for the maintenance of a good even turf. In harrowing old pastures it is not sufficient to spread the droppings only, but the tripods should be heavy enough to slightly tear the surface and allow the aeration of the surface layer of the soil.

Top-dressing with nitrogenous fertilizers to promote winter growth of grass for the early spring is now becoming a practice in dairying districts. The promotion of an early spring growth of grass is most successful where the pastures have been brought to a high state of fertility and production by means of phosphatic dressings—that is, where perennial rye-grass is the dominant grass of the pasture. Most dairying pastures consist mainly of a mixture of rye-grass, cocksfoot, and white clover. The main period of rye-grass growth is from March to December, whereas cocksfoot does not start vigorous growth till the late spring, though it throws a good deal of feed during the autumn. The quick response of pastures to winter dressings with nitrogenous fertilizers, and the amount of feed thrown, depend mainly on the amount of rye-grass present in a pasture.

MANAGEMENT AND FEEDING OF BREEDING-EWES.

Breeding-ewes on fat-lamb-raising farms should receive careful attention during July to ensure that they get sufficient exercise to keep them in a healthy condition. Ewes on turnips should be moved off at night to a bare grass-paddock, and not be put back on the crop until the frost is off the ground. Care should be exercised that the ewes are not hurried or crowded when moving from one field to another.

On or about the 146th day after putting out the rams lambs may be expected, and on North Island fat-lamb-raising farms a few lambs will be dropped during the latter part of July. The raising of early fat lambs necessitates the careful provision of feed for the early spring, and on North Island grass-farms the secret of success lies in systematic top-dressing, careful grazing, and understocking during the winter, so that some of the winter growth of grass may be saved for the spring.

A selection of well-sheltered, clean grass paddocks is very necessary at lambing-time, so that the unlambed ewes can be kept separate from the lambed ones. The ewes should be gone round each morning before breakfast, assistance given to any that require it, and any stray lambs collected and mothered.

—P. W. Smallfield, B.Ag., Instructor in Agriculture, Auckland.

THE ORCHARD.

PRUNING OF PIP-FRUITS.

CONTINUING last month's notes on the subject of pruning, it must be remembered that practically the same general principles apply to pip-fruits as to stone-fruits—that is, the building-up of a sturdy tree capable of producing the maximum amount of the best-quality fruit. It is impossible in these notes to give full details of

pruning; only a few of the chief points are mentioned in the hope that they may be of some benefit to those growers not experienced in the art. The Orchard Instructor for the district is available if required, when the many different conditions, according to locality, growth, soil, &c., can be fully discussed.

Apple-trees.

Apple-trees in the orchard may generally speaking be classed under two headings—spur bearers and lateral bearers—and it is this bearing habit that to a large extent decides the method of pruning to be adopted.

Of the spur-bearing type probably the Sturmer is the best known, while the Jonathan is a good example of the lateral-bearing type. Although the Sturmer is known as a spur bearer it does not follow that fruit will not grow on the laterals. As a matter of fact, during the past few years laterals have been cultivated in this class of tree with the best results, and in most districts this practice is to be recommended. It is quite a contrast to the old style of pruning, when the cutting of all side-growths, either back to the base or leaving a stub with one or two buds, was adopted, leaving from six to ten bare poles from which direct fruit-buds were expected to carry the future crops. On the other hand, the cutting of all side-growths in the lateral bearers—Jonathan type—back to the base to produce fruit buds or spurs usually leads to disaster.

Vigorous trees growing on good land will usually produce more laterals than are required for the welfare of the tree; consequently these should be thinned out, selecting the shorter, thinner laterals for fruit-bearing in preference to the heavier and stronger ones. In the majority of cases these laterals should be left intact the first season, allowing them to form fruit-buds during the following season. Should it be necessary to retain some of the heavy and stronger laterals in the tree, these may be cut back to a well-developed bud, probably a third of the length back from the terminal bud, but never stubbing to within two or three buds of the base. During the following season's growth these laterals should develop fruit-buds as well as make growth, either from the terminal bud or from the first and second buds nearest to the cut made. The old practice of cutting back to the fruit-buds the following year is not recommended. Sometimes this is done with the spur-bearing varieties, but much better results will be obtained by treating the growths made from the previous season's cut, reducing them to one, and cutting back three or four buds according to the growth made. This will provide for the development of foliage above the fruit-buds, with the result that better fruit will be obtained. From now on these laterals will produce fruit-buds as well as fruit-spurs, with a short extension of growth from the uppermost leaf-buds. These extensions should be tipped wherever possible to produce a little growth, and for the purpose of pumping up the necessary sap for the production of fruit.

In the case of Delicious it is sometimes found that the continual cutting of the laterals, however slight, will only produce

wood-growth. In such cases it is well to leave the laterals uncut for a season or two until such time as fruit-buds develop on the lateral, when they can be cut according to the growth made, leaving sufficient leaf-buds to carry on the growth. It must be understood that the practice of leaving these laterals uncut indefinitely is not recommended; it is only intended for heavily growing trees, and even then it will be necessary for the pruner to watch his trees, or weak spurs and buds will develop, resulting in poor, undersized fruit. With such a free spur-bearing type of tree as the Sturmer it will be found necessary as the tree matures to prune the spurs and buds, eliminating a good proportion to promote growth and prevent overcropping—serious drawbacks to the Sturmer if not properly attended to.

With the lateral-bearing type of tree it is most essential to prune to keep the tree growing vigorously and to produce new growth every season, without which the crops will gradually diminish. By studying the laterals produced on the Jonathan it will be noticed that the buds near the base are undeveloped and small. Cutting to these buds to produce growth for the following season usually results in the death of the stub. Although in some cases a small lateral may be left uncut for a season to produce fruit from its terminal bud the following season, a good practice when pruning the Jonathan is to cut every twig, the length of cut depending on the growth made, selecting a good healthy bud about one-third to one-half of its length in the case of strong laterals, and not quite as much with the laterals of medium growth. These cut laterals will produce both fruit-buds and new growth the following season. These in turn may be cut and kept growing, as upon these growing laterals the fruitfulness of the tree depends. Should growth slacken off to any appreciable extent, harder cutting must be resorted to for the purpose of renewing vigour. The leaders of the Jonathan type may also be pruned harder than the heavier-growing spur-bearing types, making the cuts to produce growth as strong and upright as possible, thus correcting the spreading habit of this class of tree.

CULTIVATION.

Where no green crops for ploughing under later in the season are being grown, and it is intended to give the orchard two ploughings, the first should be completed as soon as possible. This is preferably done, ploughing away from the trees, leaving the on-ploughing till later in the season. The action of frosts, &c., have a beneficial effect on the soil, not only sweetening it, but making later cultivation much easier.

—*G. Stratford, Orchard Instructor, Motueka.*

Citrus-culture.

The first important work among established citrus-trees at this period is to constantly guard against excess water at the roots. Under-drainage is one of the first essentials, but even where this is thought to be adequate excess water is apt to accumulate during the rainy season. A furrow opened up with the flow from low-lying areas, or a temporary surface ditch opened with a spade for

lesser areas as a means of removing excess and particularly surface-water, will repay for the timely attention. Excess, and particularly stagnant water, even though of temporary duration, is repugnant to citrus-plants.

Harvesting of lemons which attain correct size should be done, and the fruits put away for curing and storage. It is very marked that at this season lemons which are left on the trees to attain ripe condition are most susceptible to citrus brown-rot, and after harvesting readily become infected with blue mould.

Poorman oranges should be given continual attention. This is a crop which is not all available for picking at the same time. The larger-sized and earlier-colouring fruits should be picked, and the smaller sizes allowed to remain, and then picked as they progress in size and maturity. Once the earlier picking has been done it is usual to find very marked improvement in the quality of the remainder. Such extra quality is not attained where the whole crop is left until late in the season.

Where the recommended precautions have been taken to guard against brown-rot little trouble should be experienced, but it will be as well to apply a spray of bordeaux, 4–4–40, during a break of fine weather. Where brown-rot shows up every care should be taken to collect and destroy diseased fruits, rather than allow them to become the source of further infection.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

BREEDING-POINTS.

THE commencement of the hatching and rearing season is now near at hand, and the poultry-keeper should now look well ahead and have everything in perfect order for these operations. Especially where pullets are desired to commence their period of production during next autumn, when the price of eggs is on the up-grade, there must be no delay in getting the breeding-pen mated to ensure that July-hatched chicks will be produced. The best time to hatch-out chicks to lay in winter is during August or early in September, as the early-hatched pullets usually moult during late autumn or early winter. The one great advantage in having some pullets bred to lay during the autumn months is that they come into profit at a time when the adult stock commence to take their period of rest prior to moulting. By early hatching the returns are augmented at a period when, on the average plant, much is going out and little coming in. Especially where the business is being conducted on a more or less large scale the raising of a fair number of July-hatched birds will do much towards increasing profits. It is always a wise course to have the birds mated well before eggs are required for hatching purposes.

In previous notes breeders were advised to select the required hens—the late moulters—for this season's breeding-pens before the moulting process sets in, for it is then, and only then, that the best specimens for breeding can be determined. Usually the long-season layers, and naturally the late moulters, possess a more

desired type and stronger constitutional vigour than the early moulters. Thus it is from among the late moulters that the breeding specimens should be selected. Obviously it would be almost impossible to select such stock now that the whole flock has moulted. Where the timely advice was acted upon, and the late moulters and best breeding types were selected and marked accordingly—say, late in March—the work of mating will now be a simple matter. It is true that owing to developing some weakness odd birds may have to be discarded in the final selection; but in a general way, and where the work has been carried out by an experienced person, the remaining birds will be the pick of the flock from almost any standpoint.

Those who have neglected to select the late moulters during the autumn will not only find the work of mating a troublesome business, but a high proportion of undesirable stock may also be expected as a consequence. While lateness of moulting can generally be accepted as indicating good producing-power, it is not to be inferred that all late moulters are suitable specimens for the breeding-pen. If a uniform flock is to be built up and maintained something more is required. If this is to be achieved the breeder must have an ideal type fixed in his eye, and keep this always in view, remembering all the time that constitutional vigour must go hand in hand with that type. Health and vigour form the base of all successful breeding operations. The usual signposts to these essential requirements are a clean face, clear bright prominent eyes, short shanks set wide apart, alert carriage, and tight thick feathering.

The question of size is another important matter. Small undersized specimens of their breed should be rejected however well they have laid. Such stock usually produce weedy progeny which yield only second-grade eggs, which are next to useless for the export trade. The production of small eggs is probably one of the greatest weaknesses in connection with present-day poultry-keeping. The size of eggs can be increased only by careful breeding, and by the selection for breeding of only those birds which lay good-sized eggs. Of course, on most plants there will be found more or less variation in type among the individual birds. This being so, an endeavour should be made to classify the hens, and to mate with them a male strong in points where the females are weak, or *vice versa*. For example, where hens show a tendency to be on the small side, weak in front, and loose feathered, or carrying an excessive comb, &c., a male should be selected strong in these points.

In a general way, the qualifications to be looked for in a good breeding male, as indicating constitutional vigour and breeding-power, are good chest-development, width across the back, tight feathering, and an alert bold carriage. While feminine characters should be looked for in the female, the male should be practically at the other extreme. The head should be masculine in every respect, but without coarseness. In addition, he should be the progeny of a heavy-laying hen producing good-sized eggs. Where old cocks are used for mating, about three parts of the spurs should be removed. A fine saw will serve for the purpose, as practically no bleeding will take place if a little Stockholm tar is

applied to the cut part. Long sharp spurs are not only a common cause of infertile eggs being produced, but of hens' sides being badly ripped as well. To ensure a high percentage of fertile eggs containing strong germs it is of the first importance that the male be maintained in the best of health and vigour. It is a good plan to frequently handle the breeding males, and when a bird is found to be out of condition he should be removed and given a good dusting with insect-powder and replaced by another. When it is found necessary to remove a male from the breeding-pen it is a mistake to keep him confined in a coop by himself, as he is apt to fret and cease to thrive. He will do much better if given the company of one or two hens, preferably birds that are not laying.

PRODUCTION AND EXPORT.

According to returns compiled by the Government Statistician, there was on 31st March last 835,097 lb. of egg-pulp cold-stored in the Dominion for use by large consumers during the scarce season, as compared with 591,781 lb. on the corresponding date of last year. On 31st July last, or what might be termed the beginning of the flush and cheap season, a carry-over of 83,049 lb. was recorded, indicating that 508,732 lb. was used between 1st April and 31st July, 1927. Thus, if a similar quantity is used during the four corresponding months of this year, there will be a carry-over of 326,365 lb. at the end of July next. If this amount is added to the extent of some 182,000 lb. there should be approximately sufficient pulp for the current winter season, while obviously there will be a greatly increased number of eggs available for the retail trade.

The foregoing analysis, and the almost safe assumption that there is a decidedly increased number of fowls in the Dominion as compared with last year, goes to indicate that in all probability there will be a surplus of eggs beyond the requirements for the local trade during the coming spring. Should such be the case, there is every reason to believe that the price of eggs will fall below a paying price for the producer (in view of the present high cost of production in the way of foodstuffs) unless advantage is taken of the overseas trade which is offering. The shipping of eggs from New Zealand to the London market has now passed the experimental stage. It has been proved beyond doubt that our eggs can hold their own against those of other competing countries when nothing but good-sized and good-quality produce is shipped. If eggs are to be exported during the coming spring, when they will return the best possible paying values, there must be no such thing as "near enough" in regard to quality. No egg should be packed unless weighing 2 oz., and perfect in all other respects, including clean shells. Not only this, but the overhead charges as compared with those obtaining hitherto must be reduced.

If such necessary reforms are to be brought about, and the export trade placed on a sound footing, early organization and joint action on the part of producers is imperative. The sooner producers realize that they cannot afford to be disunited when it comes to exportation the better will it be for their own pockets and the industry as a whole.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

THE DORMANT SEASON.

DURING the months of June and July activities in the apiary, so far as the bees are concerned, should cease. No advantage is to be gained by interfering with the bees, providing the colonies have been left with ample stores, queen right, and well supplied with mats to conserve the heat of the cluster. After heavy rains it is advisable to remove the roofs to ascertain the condition of the mats, and if any are found to be damp they should be removed. This can be done without disturbing the bees. Damp mats should not be tolerated, as they are harmful to the health of the bees at all seasons of the year, and more particularly during the winter months when dormant colony conditions obtain. As advised previously, a plentiful supply of mats should always be on hand.

MOVING OF BEES.

Providing sufficient care is taken, bees may be moved long distances with perfect safety at this season. It is not advisable to delay this work until the spring, as brood-rearing will then have commenced in earnest, and the numerical strength of the adult bees will be greater than at this period. Moreover, there is little brood in the hives to be injured. When moving bees short distances—say, up to a couple of miles—little preparation is necessary beyond screening the entrance with wire gauze, and fastening the bottom-boards and roofs with crate staples or battens. It is well to choose a cold night before closing the entrances of the hives to be removed. On arrival at the new location the bees should be allowed to settle down prior to removing the gauze. It is quite a good plan to place some obstruction—a piece of board will suffice—in front of the entrance, as this will cause the bees to investigate and take new bearings. Some such action is necessary to prevent the field-bees from returning to the old location.

When removing bees long distances, which may necessitate their confinement to the hives for a lengthy period, it is essential that they be well packed so as to allow of ample ventilation. To safeguard against suffocation of the bees the hives require to have wire screens top and bottom. The screens can be made by using narrow laths nailed together to form a frame of the same dimensions of a hive-body, and covering this with wire cloth. When placing the screens on the hives proceed as follows:—

The evening before removal, after the bees are all in, place a frame alongside each hive level-side up. Gently lift the hive on to the frame. Next remove the cover and mat, and place the upper frame level-side downward in position. The bees being now secure, the battens to hold the frames can be nailed on the following morning. Place a hive-cover over the frames in the event of rain falling during the night. When railing bees, the frames should run parallel with the truck, but with road transport the reverse should be the case. This rule should be followed to prevent the frames from rocking and thus killing the bees.

It is well to remember that (as a precaution against the spread of disease) bees cannot be removed a distance of more than 10 chains

without the written consent of an Inspector. Failure to obtain the necessary consent renders a person liable to a fine not exceeding £25.

THE WINTER OVERHAUL.

During the winter months, as opportunity offers, the working-plant of the apiary should be carefully overhauled. The engine, extractor, and tools require to be examined, and defective or broken parts replaced, so as to have all in readiness for next season's work. It is not wise to leave the repairing and painting of spare roofs, hives, and bottom-boards until they are required to be brought into use. Now is the best time to lay down future plans; and if an increase in the number of colonies kept is decided upon, or the establishment of an out-apiary is being considered with the object of increasing income, no time should be lost in getting together the required number of extra hives, supers, roofs, and bottom-boards, also in the preparation of frames and the fitting of comb-foundation.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

EARLY SPRING WORK.

With the month of July the halt between the growing-season ends, and some growth is made by the hardier plants on the lighter lands in the warmer localities. It is for those engaged in horticulture to start sowing and planting as early as the preparation of the land and the season permits, in order to spread, as far as possible, the glut of work that comes round with every spring. There is also the natural desire to make full use of the growing-period—an economy which is sometimes neglected. In the case of light lands that are inclined to be over-drained an early start with the planting-season is of special urgency. On colder and heavier soils it is a time to expedite the preparation of the land for the earlier crops, remembering that good and timely preparation solves most of our problems. It is a time to plough-in green crops for manure, or such of the slower-acting manures as bonedust or organic manures from the stock-yards. These are slow and lasting in their action and effect, and are usually turned in deeper than the more soluble dressings applied shortly before planting and sowing.

As soon as the land is in condition, plant out main-crop cabbage and cauliflower, and lettuce and autumn-sown onions from the plant-beds; also shallots, garlic, and artichokes. In some localities early potatoes may be planted now. Of the more important crops that may be sown early are cabbage and cauliflower for summer use, lettuce, spinach, early peas, and broad beans.

The winter crop of vegetables planted last summer gave poor results in localities that suffered from dry weather at that period; elsewhere good crops were obtained. Savoys, leeks, and celery will now be nearly finished, and the broccoli planted then will soon be maturing. Clean up this land as soon as it is available; it is probably in rich condition, and very suitable for shallow-rooting

crops such as lettuce, onions, peas, &c. The celery crop suffered—rather badly in some places—from "late blight" (*Septoria Petroselini*). Where this occurred all waste should be burnt to prevent soil-infection. This trouble may originate from the soil or the seeds, and demands close attention.

The spring cabbage and cauliflower crops planted in late autumn will be making increased growth; also the plantings of rhubarb and asparagus. These should now be assisted by suitable hoeing and cultivation, with occasional dressings of fertilizers.

Seedling tomato-plants will soon be ready for pricking out into boxes. If the condition of the soil is doubtful and means for sterilization are not available, water the soil in the boxes with boiling water the day before pricking out the plants. Carefully avoid high temperatures in the houses and frames, and have a few heaters handy to combat late cold snaps that occasionally occur in some districts. Complete the preparation of the soil in the glass-houses which are later to be planted out in tomatoes. This should be completed in good time to allow it to settle and firm before planting.

Brakes of bush-fruits should be sprayed before they start into growth; a good 8–6–40 bordeaux will be most generally useful. Make an application of fertilizers where necessary. At this season avoid deep cultivation among fibrous-rooted plants of this class, as it is apt to check the growth and cause serious debility in most instances.

SMALL TRIAL AREAS OF TOBACCO.

Those who purpose to grow a small trial area of tobacco this season should carefully consider each operation, particularly that of sowing. This plant is classified as a half-hardy annual—that is, its susceptibility to frost is about equal to that of the tomato, potato, and other plants of that class. For this reason it is not until the month of October or early in November that it can be planted out in the open without undue risk. This planting-out period must be decided after considering all the circumstances. It is desirable to make the decision as early as possible, and that will depend on locality, climate, and available shelter. An approximate planting-period being decided, the operation of sowing the seed is to be considered. The period necessary for growing plants for the field will be from two to three months, according to the climate and the skill of the operator. For experimental purposes it is as well not to press the point of early planting, but the aim generally should be to be ready to put out the plants during the first fortnight of November. To do that the seed should be sown during August, and it is time now to make the necessary preparation. In some cases it is the custom to have the seeds germinated in boxes under glass by a nurseryman, and delivered to growers early in the month of September in a suitable hardened condition for pricking-out into sheltered beds. In many cases this will be the best plan to adopt; the grower then has only to prepare the beds in readiness for the seedlings. Naturally, the site for these should be well drained and sheltered, and the soil friable and of good quality.

Commercial beds are made about 6 ft. wide and as long as necessary. The soil is sometimes steamed or burnt at this season

to destroy weeds and pests that may interfere with the diminutive seedlings. For pricking-out a small number of plants for experimental purposes a piece of land in good heart in the house-garden will probably meet the case. For purposes of protection, the bed should be boxed by surrounding it with a board on edge projecting 6 in. above the ground, and on which cheese-cloth may be stretched to protect the young plants.

The advantage of sowing the seeds in boxes or pans first is that they can be given the shelter of a glasshouse or frame. If this is done on the farm, shallow-tray boxes should be used and filled with good sweet friable soil. A useful measure of sterilization may given here by watering the boxes with boiling water. The following day the seed may be sown thinly and pressed into the soil. A very light dusting of sifted sand may be added, although it is hardly necessary. Cover the boxes with glass and a sheet of paper to retain moisture and afford shade, and place them in a moderately warm house or frame. As soon as the seeds germinate, gradually remove the covering, and give them light and air. They will be ready for pricking out when the first rough leaves develop.

TOOLS AND IMPLEMENTS.

Good results depend not only on a right judgment in planning, but to a very great extent also on well-timed skilful execution. The ease and skill with which operations are carried out depend very much on the class and condition of the tools used. Experienced workmen realize this, and they are very quick to carefully consider new samples or suggestions regarding the tools and implements of their craft. The most desirable features are, first, that of being able to lay one's hand on an implement without hunting for it, and, second, to find it in a serviceable condition.

Most of us will find under this heading that decided economies may be made, while the work is more easily performed and the pleasure of skilful achievement takes the place of what may easily become slow, uninteresting drudgery. This applies just as much to horse-drawn implements as those used by hand, although in the latter instance the disability may be more easily realized.

The wooden shaft of most hand implements when new is in a more or less natural state, except for the shaping. If the handle is rubbed down with sandpaper for a few moments and then dressed with boiled linseed-oil the difference will be much appreciated by the user, who will find the easier manipulation a great assistance. One or two more applications of oil, and natural use will give the shaft a high polish of the best kind.

Most edged tools when bought are unground, with merely more or less indication of the bevel to be given. Before use they have to be ground on a grindstone, and finished on a whetstone, if a sharp cutting-edge is required. A budding-knife, secateurs, scythe, spade, hoe, shears, or lawn-mower vary very much in the quality of the steel and the width and angle of the bevelled cutting-edge. These demand careful study if the implement is to make work pleasant and profitable by means of rapid and skilful execution. The slow labour of the grindstone is often replaced nowadays with the hard steel rasp that

cuts the shoulder off an edge and forms a bevel on a new implement very rapidly. This instrument should be used with careful restraint: so effective is it that the steel is actually whittled away with careless use. For a fine knife-edge carborundum stones are required to finish the job.

One often sees implements left out in the ground overnight, or sometimes even after a job is finished until they are required again. Under such circumstances the condition of the implement is very rapidly destroyed, and after a very short period of this treatment it is almost impossible for it to be replaced. Moisture, acidity, and decay destroy the surface of the wood and iron, even after merely a comparatively short exposure. It is sometimes necessary to leave large implements out overnight, but they should be well painted, covered with a waterproof cover, or, as in the case of a plough, left in such a way as to suffer as little as possible from the exposure. A plough, for instance, is best left on the headland with the point of the share on the surface in a position to go straight ahead when work is recommenced. If the mouldboard and share are half-buried in the soil, the surface of the metal becomes pitted and rough, especially if owing to bad weather it has to remain there a few days. If it is left on the surface and rubbed clean it will suffer least and quickly repolish after a little use. Hoes, spades, and suchlike implements should always be rubbed or washed clean after use, and stood in a rack under cover; with occasional sharpening they will then be always at hand and in serviceable trim. Such sharp-edged tools as budding, grafting, and pruning knives are best cleaned, sharpened, and greased after use and put away in a drawer.

Such practices as these enable the workman to ignore the tools while using them, and give the whole of his attention to the operation being carried out. So important are these facts regarded by practical men of experience that it is commonly considered a true judgment of a man's ability may be arrived at by an inspection of the tool-shed.

—W. C. Hyde, Horticulturist, Wellington.

MILKING SHORTHORNS AT RUAKURA STATE FARM.

The stud bull Pukerimu Premier and some of the two-year-old heifers.

IMPORTATION OF FERTILIZERS, 1927–28.

Chemistry Section.

STATISTICS of artificial fertilizers imported into New Zealand during the year ended 31st March, 1928, have been prepared as usual from figures specially supplied by the Comptroller of Customs, and are presented in the accompanying tables, together with comparative data for preceding periods.

TABLE 1.—SUMMARY OF FERTILIZER IMPORTATIONS, 1927–28 AND 1926–27.

Fertilizer.	Quantity.		Declared Value.	
	Year 1927–28.	Year 1926–27.	Year 1927–28.	Year 1926–27.
	Tons.	Tons.	£	£
Bonedust	725	4,805	6,229	15,932
Bone-char	201	..	662	..
Basic slag	48,913	53,327	133,400	185,139
Superphosphate	6,616	15	18,304	89
Nauru and Ocean Islands phosphate	89,169	125,709	113,459	165,803
Island phosphate (other)*	54,204	35,832	80,236	56,868
Egyptian phosphate	6,603	5,979	19,974	18,730
American rock phosphate	..	21,977	..	32,485
Nitrogenous guano	18,947	..	27,413	..
Phosphate (other)	20,030	..	39,216	..
Kainit	786	2,195	2,164	6,295
Muriate of potash	23	..	198	..
Sulphate of potash	1,502	2,016	14,809	19,740
Potash (other)	4,267	6,474	18,913	27,565
Sulphate of ammonia	1,077	957	16,239	12,862
Nitrate of soda	1,021	1,466	11,699	17,057
Sulphate of iron	131	61	1,332	658
Fertilizers unspecified	84	57	1,344	640
	254,299	257,870	505,591	559,863

*For details see Table 3.

TABLE 2.—IMPORTS OF THE PRINCIPAL PHOSPHATIC FERTILIZERS, 1918–28.

Year ended 31st March,	Bonedust.	Basic Slag.	Superphosphate.	Pacific and Indian Oceans Phosphates.	Egyptian Basic Phosphate.
	Tons.	Tons.	Tons.	Tons.	Tons.
1918	6,363	10	37,157	37,037	11,225
1919	3,468	Nil	21,400	31,351	Nil.
1920	6,272	2,759	15,842	38,861	15,000
1921	4,440	10,823	40,731	70,208	10,810
1922	4,063	13,488	3,140	45,956	Nil.
1923	2,446	19,641	Nil	69,591	,,
1924	4,158	39,632	255	76,517	5,996
1925	2,452	45,682	10	108,163	8,530
1926	2,085	44,314	500	97,488	10,037
1927	1,805	53,327	15	161,541	5,979
1928	725	48,913	6,616	143,373	6,603

TABLE 3.—IMPORTATION (IN TONS) OF PRINCIPAL ARTIFICIAL FERTILIZERS FOR YEAR 1927–28, SHOWING COUNTRIES OF ORIGIN AND NEW ZEALAND PORTS OF ENTRY.

New Zealand Port of Entry.	Australia.		Chile.	India.	Morocco.	Netherlands.	Pacific and Indian Oceans Islands.		United Kingdom.	Belgium.		France.		Germany.		Egypt.
	Sulphate of Ammonia.	Bonedust.	Nitrate of Soda.	Bonedust.	Phosphate.	Superphosphate.	Name of Island.	Phosphate.	Basic Slag.	Basic Slag.	Potash.	Basic Slag.	Potash.	Basic Slag.	Potash.	Phosphate.
Auckland ..	372	25	1,000	680	4,206	..	New Caledonia	4,480	4,915	18,280	65	1,185	1,255	4,595	1,084	..
							Nauru ..	32,667								
							Ocean ..	34,115								
							Makatea ..	12,180								
							Seychelles ..	1,797								
New Plymouth ..	50	..	..	..	3,322	..	Nauru ..	15,459	3,436	8,025	1	750	395	350	273	..
Patea	..	..	..	..	..	..	..	..	..	..	30	..	..	..	..	..
Wanganui ..	65	..	..	..	3,050	..	New Caledonia	1,840	..	..	..	..	..	..	..	..
							Nauru ..	16,861								
Napier	..	..	..	..	..	..	..	..	..	..	20	..	15	..	13	..
Wellington ..	97	..	..	20	..	..	..	..	2,779	2,534	30	68	353	226	139	2,603
Nelson ..	5	..	..	..	..	..	..	..	..	75	..	..	80	..	53	..
Westport ..	..	..	..	..	..	..	..	..	..	25	..	..	..	..	..	..
Lyttelton ..	220	..	20	..	2,811	..	Walpole ..	1,700	50	5	..	25	248	..	170	1,000
							Ocean ..	5,800								
							Nauru ..	13,727								
							Makatea ..	2,097								
Timaru	..	..	1	..	..	..	..	..	..	30	..	..	35	..	60	..
Dunedin ..	108	..	..	..	..	..	Ocean ..	1,840	225	305	25	..	340	50	265	..
							Seychelles ..	1,620								
							Nauru ..	7,403								
Invercargill ..	86	..	..	..	..	6,536	Seychelles ..	5,870	25	955	..	..	1,041	..	608	3,000
							Walpole ..	1,605								
							Nauru ..	1,212								

WEATHER RECORDS: MAY, 1928.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE month of May was on the whole a wet and rather stormy one. The season is still (early in June) characterized by a relative absence of westerly winds. When strong winds have blown, they have frequently been along the length of the Islands, so that many parts, notably the Cook Strait region, have escaped their severity. They were felt mainly in the northern parts of the Auckland Province, the Foveaux Strait region, and the surrounding ocean waters. Rainfall was above the average over almost the whole of the North Island. In the South Island more varied conditions prevailed, most of the western districts having more, and most of the eastern districts less, than the average.

Temperatures remained rather mild, scarcely any frost being experienced over the greater part of the North Island. In the South Island, however, winter weather was experienced after the first week, and frosts were fairly frequent. These were compensated for by many bright and sunny days.

The month opened with an intense anticyclone centred to the west of Westport. The weather was stormy, with gales in many places. Very heavy rain was recorded in the central provinces.

Unsettled conditions continued over the whole of the first week. Westerly gales due to depressions of a westerly type blew on the 4th and 5th. On the 6th a cyclone appeared to the south of Norfolk Island, and subsequently developed two centres, one of which passed through Cook Strait and the other north of Cape Maria Van Diemen. This was an active disturbance. Strong northerly gales were experienced during its approach, and south-westerlies after its passage. It was followed also by a decided fall of temperature, which practically marked the commencement of winter for the South Island. Frosts were frequent in Canterbury and Otago from then onwards, and the mountain-tops were covered with snow. Another vigorous cyclone crossed the South Island on the 14th, and brought heavy rain, especially to the North Island. High floods caused damage in Kaitaia and the surrounding districts. A fourth cyclone crossed the North Island on the 18th, and was followed by southerly gales, which covered an extensive area over and on all sides of the Dominion. Seas were rough for several days in the surrounding ocean waters.

During the passage of an anticyclone over the southern portion of the Dominion on the 24th and 25th, barometers rose as high as 30·7 in. The only other anticyclone of any intensity was one which covered New Zealand on the 10th.

The tendency for disturbances to assume the cyclonic form was maintained until the end of the month. Further examples of this type of storm controlled our weather on the 26th and the 29th.

RAINFALL FOR MAY, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall	Average May Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	8·00	17	3·20	5·06
2	Russell	9·01	14	3·58	5·92
3	Whangarei	11·73	21	4·44	7·84
4	Auckland	10·42	30	3·10	4·50
5	Hamilton	9·23	23	2·10	4·54
6	Kawhia	7·61	24	1·44	5·57
7	New Plymouth	7·09	22	1·14	6·23
8	Riversdale, Inglewood ..	9·64	19	1·64	9·82
9	Whangamomona	10·93	14	1·63	7·05
10	Eltham	5·44	17	1·10	5·27
11	Tairua	13·22	17	4·54	7·64

RAINFALL FOR MAY, 1928—*continued.*

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
	North Island —continued.	Inches.		Inches.	Inches.
12	Tauranga	9·59	19	3·42	5·16
13	Maraehako Station, Opotiki	8·78	15	2·50	5·70
14	Gisborne	5·40	12	1·97	5·67
15	Taupo	8·39	15	2·19	4·09
16	Napier	6·66	19	1·27	3·74
17	Maraekakaho Stn., Hastings	5·45	16	1·57	3·52
18	Taihape	3·78	18	0·58	3·84
19	Masterton	4·81	19	0·84	4·03
20	Patea	6·02	21	1·07	4·34
21	Wanganui	4·51	17	0·80	3·42
22	Foxton	8·06	16	2·16	2·78
23	Wellington (Karori Reservoir)	4·95	16	0·92	4·40
	South Island.				
24	Westport	9·32	22	1·92	6·58
25	Greymouth	8·69	19	1·65	8·01
26	Hokitika	10·97	19	2·37	9·71
27	Ross	13·09	14	3·38	9·73
28	Arthur's Pass	15·99	16	3·65	11·02
29	Okuru, Westland	7·32	7	2·50	11·60
30	Collingwood	7·94	17	1·69	10·18
31	Nelson	4·12	13	1·01	3·08
32	Spring Creek, Blenheim	2·98	13	0·75	3·19
33	Tophouse	7·56	14	2·25	5·94
34	Hanmer Springs	4·18	13	1·11	4·51
35	Highfield, Waiau	2·42	7	0·70	3·41
36	Gore Bay	3·66	12	0·96	3·83
37	Christchurch	2·29	11	0·83	2·65
38	Timaru	2·06	11	0·96	1·41
39	Lambrook Station, Fairlie	2·08	9	1·16	1·53
40	Benmore Station, Clearburn	1·54	12	0·58	1·97
41	Oamaru	1·42	11	0·40	1·61
42	Queenstown	1·87	9	0·50	2·63
43	Clyde	0·69	8	0·16	0·97
44	Dunedin	1·33	11	0·35	3·23
45	Wendon	1·22	8	0·33	2·23
46	Gore	1·65	14	0·35	2·71
47	Invercargill	3·54	16	0·64	4·46
48	Puysegur Point	10·04	24	1·32	6·81
49	Half-moon Bay, Stewart Is.	5·31	22	1·14	4·50

FERTILIZER IMPORTATIONS: MARCH QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the three months ended 31st March, 1928:—

Sulphate of Ammonia.—Australia, 262 tons; United States of America, 50 tons. *Basic Slag.*—United Kingdom, 6,266 tons; Belgium, 18,422 tons; France, 2,000 tons; Germany, 5,221 tons. *Guano.*—United Kingdom, 10 tons; New Caledonia, 4,418 tons. *Rock Phosphate.*—Nauru and Ocean Islands, 9,059 tons; Makatea Island, 1,909 tons. *Phosphates (other).*—Belgium, 4 tons; Morocco, 13,389 tons. *Kainit.*—Belgium, 10 tons; France, 257 tons; Germany, 36 tons. *Muriate of Potash.*—France, 5 tons. *Sulphate of Potash.*—Belgium, 15 tons; France, 251 tons; Germany, 185 tons. *Potash (other).*—Belgium, 56 tons; France, 728 tons; Germany, 467 tons. *Sulphate of Iron.*—United Kingdom, 3 tons; Australia, 51 tons. *Other Manures.*—Germany, 53 tons.

BOYS' AND GIRLS' AGRICULTURAL CLUB COMPETITIONS.

DOMINION CHALLENGE SHIELD.

RECOGNIZING the great educative value of boys' and girls' agricultural clubs, Messrs. Henry A. Lane and Co., of London, through their Hawera representative, Mr. G. A. Buckeridge, have presented to the Department of Agriculture a handsome challenge shield for competition among the schools taking part in the movement. The shield is to be won and held for the year by the school gaining the most points in the various competitions, such as calf-rearing, root-growing, or any other that the executives of the clubs may introduce; also points won at shows by exhibits entered in special classes confined to club competitors.

Schools taking part should keep a careful record of all prizes won by them, including, where possible, a newspaper report of the competition. These records should be forwarded to the Instructor of the Department of Agriculture for the district at the end of July in each year. The Instructor, after checking, will forward a report to his head office, where the award will be made. The Department will present each winning school with a photograph of the shield as a suitable record.

Points for the various competitions are as follows:—

(1) At the actual competitions—
  Championships, 1st, 2nd, 3rd; points, 3, 2, 1.
  Groups, 1st, 2nd, 3rd; points, 3, 2, 1.

(2) At agricultural and pastoral shows—
  Championships, 1st, 2nd, 3rd; points, 3, 2, 1.
  Classes, 1st, 2nd, 3rd; points, 3, 2, 1.

(3) At winter shows—
  Championships, 1st, 2nd, 3rd; points, 3, 2, 1.
  Groups, 1st, 2nd, 3rd; points, 3, 2, 1.
  Classes, 1st, 2nd, 3rd; points, 3, 2, 1.

Points for the percentage of children that are eligible in each school actually taking part in the competition are to be awarded, but no percentage points will be allowed for competitors at the agricultural and pastoral and winter shows. The points for eligible competitors are computed as follows: For 20 per cent. of eligibles, ½ point; for 30 per cent., 1 point; and so on, increasing by ½ point for each additional 10 per cent. up to 10 points maximum for 100 per cent. of eligible competitors.

WHEAT AND OATS THRESHINGS.

TABULATED below are returns of actual threshings received by the Census and Statistics Office up to 19th May from threshing-mill owners, and covering the months of January to April, 1928, inclusive:—

Land District.	Wheat.		Oats.	
	Quantity threshed.	Average Yield per Acre.	Quantity threshed.	Average Yield per Acre.
	Bushels.	Bushels.	Bushels.	Bushels.
North Auckland ..	806	15·50	..	..
Auckland	311	18·29	..	..
Gisborne	1,947	26·31	304	30·40
Hawke's Bay	10,884	33·39	13,155	34·89
Taranaki	2,696	50·87	230	38·33
Wellington	72,124	34·90	40,302	41·42
Nelson	28,711	28·97	9,596	30·56
Marlborough	88,212	30·10	35,093	31·28
Canterbury	5,357,178	40·15	1,715,627	44·77
Otago	723,246	35·22	560,170	48·84
Southland	114,134	34·93	580,034	47·57
Totals ..	6,400,249	39·08	2,954,511	45·61

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SOWS NOT COMING IN SEASON.

"DAIRY-FARMER," Bulls :—

I should be grateful for any information you could give me regarding sows not coming in season. I have two sows (not maidens) which have been running with the boar for about two months. They are in fair store condition, have a good run, plenty of shelter, and are fed with skim-milk, lucerne, and carrots. The boar has proved himself right by effectively serving a neighbour's sows. This in not the first time my sows have failed to come in season, as I have known them to go for months after their last litter before coming on again.

The Live-stock Division :—

As the sows have not appeared in season for two months, the trouble would seem to be due to a lack of concentrates in the feed ration. It is recommended that you separate the sows from the boar, and feed the sows some concentrate such as linseed-meal and bran, in addition to what they are at present receiving. The bran and meal may be used in equal parts, allowing about 3 lb. of the mixture per head per day. Crushed beans or peas may be used instead of linseed if more convenient. The addition of some mineral such as iodine may be made with advantage as follows: Dissolve 1 oz. of potassium iodide in 1 gallon of water, and mix in the feed one tablespoonful of this solution once a day for each sow.

ELIMINATION OF RUSHES IN GRASSLAND.

"SETTLER," Gisborne :—

Please advise the remedy for rushes persistently coming up on reclaimed swamp-land. In spite of repeated cuttings (or, rather, digging out) the common rush continues to give trouble, although the ground is very well drained. I am told the ground is sour and in need of top-dressing. The grass thereon—clover, rye, and crested dogstail—flourishes, and is well kept down by stock.

The Fields Division :—

Change of soil and pasture conditions in sufficient degree is essential for the suppression of rushes. Draining the land and the subsequent removal of the plants by digging are important factors in their suppression; other agents that also contribute considerably to the elimination of the plant on grassland include applications of sufficient lime, appropriate manuring, and satisfactory stocking. You are recommended to make an application of lime at the rate of 1 ton per acre and also a dressing of 3 cwt. of basic super per acre, either at the present season or during early spring. This will improve both soil-conditions and pasture. The pasture should then be judiciously stocked; it is advisable that the sward be depastured on a system of rotational, in contrast to close and continuous, grazing. This means periodical closing of the area until the pasture attains a reasonable degree of growth and afterwards heavily stocking to ensure as far as possible the uniform eating-down of the herbage.

TROUBLE WITH CASTRATION WOUND IN HORSE.

E. TOLME, Aria :—

I have a gelding rising three years old which was castrated at the end of March, but so far the wound has not quite healed up, and there is a raw-looking piece of tissue hanging down from one of the incisions which was made when he was being operated upon. The piece hanging down is about as thick and half as long as an ordinary man's forefinger. It appears to me to be the end of the testicle-string covered with proud flesh. Will you kindly advise me how to treat the case?

The Live-stock Division :—

The piece of tissue protruding from the castration wound may only be a piece of omentum, and, if so, is quite easily removed. On the other hand, if as you suggest it is testicle string or cord, then more care will have to be exercised. If only omentum it will be fairly soft, and you will be able to pull it out a little and cut it off with a red-hot iron—the same kind of iron as is used for line-firing horses' legs. After it is seared through it will slip back out of sight and you will have no further trouble. If it is the cord that is diseased then the animal would require to be properly dealt with by a qualified veterinary surgeon, or one accustomed to castration who knows how to deal with such eventualities. In this case the animal would have to be cast and chloroformed, and after a clamp had been put on high up, the end of the diseased cord would be taken off either by the hot iron or by any other surgical means. Another treatment (which could not be altogether recommended) would be to slip over the protruding tissue a piece of strong whipcord in the form of a clove hitch, and pull up tight, leaving the two ends of the string long enough to be tightened every second day until the protruding piece of tissue dropped off. If following this treatment, give all round the part a good painting with iodine before and after operating, and frequently clean it up with antiseptic solution.

PLANTING LOMBARDY POPLAR CUTTINGS.

C. D. SUTTON, Te Horo :—

Please advise the best time and method for planting Lombardy poplar cuttings. I thought of putting in cuttings about the thickness of one's arm.

The Horticulture Division :—

The present time is very suitable for planting cuttings of the Lombardy poplar. Large cuttings such as you describe would very possibly grow, but it is customary to make them of wood about ⅝ in. in diameter and about 9 in. long, inserting two-thirds of the length in the ground. Such a cutting will make a better tree in every way.

HEIFER WITH LUMPY JAW.

A. H. J., Pokeno :—

A heifer of mine (now rising two years) developed a large swelling under her lower jaw last season. This afterwards went down, but developed again this season, and has now moved round to the right side of the jaw, and appears as a bad attack of mumps. The animal has always been in good condition and health otherwise, and does not appear to be affected in any way by the swelling. I would appreciate any information regarding this trouble.

The Live-stock Division :—

The swelling is almost certainly the condition known as "lumpy jaw." This is the common name for the disease technically known as actinomycosis, and is caused by a particular kind of fungus finding its way into the animal's system, usually through wounds in the mouth. The wounds caused by the shedding of the teeth are believed to be a fruitful starting-point for this disease, and thus the affection is usually seen in young cattle. Another phase of this disease is seen in the condition known as "wooden tongue." In this affection the tongue swells up, causing profuse salivation and great difficulty in swallowing. When the tongue only is affected recovery can be expected in the majority of cases if taken in hand early; but where the jaw is affected treatment may not be nearly so successful. If the swelling is hard, and is found on manipulation to be firmly adherent to the jaw, treatment is hardly recommended, except in the case of a very valuable animal. The treatment found so successful in wooden tongue is to drench the beast with a solution of potassium iodide in a pint of warm water twice daily. The dose of potassium iodide for each drench is 2 drams for an ordinary cow. For a small heifer the dose should be less—say, 1 dram—according to age and size. This treatment should be continued for a week, but may have to be carried on for another similar period, according to results. If the animal seems off colour the treatment must be stopped after four or five days. Actinomycosis is a contagious disease scheduled under the Stock Act, so should be reported to a Stock Inspector.

STRAINING FENCING-WIRE.

"JINNY," Hatuma :—

Is it necessary when straining fencing-wire to stretch the wire—that is, go along the fence and pull sideways on the wire?

The Fields Division :—

It is advisable to stretch the wire in the way you suggest, or in some similar way, in order to avoid the necessity which will arise if this is not done of straining the wire almost immediately again.

STOCK SLAUGHTERED, 1927-28.

THE following are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1928 :—

Stock.	Abattoirs.	Meat-export Slaughterhouses.	Bacon-factories.	Ordinary Slaughterhouses.	Totals.
Cattle ..	160,781	220,831	..	81,027	462,639
Calves ..	41,272	120,015	..	2,093	163,380
Sheep ..	641,907	2,300,069	..	238,298	3,180,274
Lambs ..	130,905	5,776,321	..	25,194	5,932,420
Swine ..	121,763	259,114	49,686	24,834	455,397

FORTHCOMING WINTER SHOWS.

South Taranaki Winter Show Company: Hawera, 27th June to 4th July.
Auckland Winter Show Association: Auckland, 11th to 21st July.
Canterbury A. and P. Association: Christchurch, 11th to 25th August.
Wellington Winter Show Association: Wellington, August (dates not yet fixed).

PUBLICATIONS RECEIVED.

MONOGRAPH ON THE NEW ZEALAND BEECH FORESTS: Part II. The Forests from the Practical and Economic Standpoints. By L. Cockayne, F.R.S., Ph.D., F.N.Z.Inst. New Zealand State Forest Service, Wellington. Price 2s. 6d.

CLASSING THE CLIP: A HANDBOOK ON WOOL-CLASSING. By E. C. Cowley, Lecturer in Charge, Sheep and Wool Department, Technical College, Sydney, N.S.W. Angus and Robertson, Ltd., 87 Castlereagh Street, Sydney. Price 15s.

THE REPRESENTATION AND ORGANIZATION OF AGRICULTURAL WORKERS. International Labour Office, Geneva. Price 3s. (British publisher, P. S. King and Son, Ltd., 14 Great Smith Street, London S.W. 1.)

IODINE FOR LIVE-STOCK. By F. E. Corrie, B.Sc., N.D.A., N.D.D. De Gruchy and Co., Ltd., 45 Mitchell Street, London E.C. 1. (Gratis on application to publishers.)

YOUR TRACTOR: ITS CARE AND MANAGEMENT. British Imperial Oil Co., Ltd., New Zealand.

Noxious Weeds Order.—The Rangitikei County Council has declared hemlock (*Conium maculatum*) and tutsan (*Hypericum Androsæmum*) to be noxious weeds within that county, the special order taking effect on 1st June.